THE KOOTENAY VALLEY

A REPORT ON CERTAIN CASES INVOLVING RECLAMATION AND THE DEVELOPMENT OF WATER POWER IN THE VALLEY OF THE KOOTENAY RIVER, UNDER THE TERMS OF ARTICLE IV OF THE TREATY OF JANUARY 11, 1909

HEARD BEFORE THE

INTERNATIONAL JOINT COMMISSION

OTTAWA AND WASHINGTON

1935

OTTAWA
J. O. PATENAUDE, I.S.O.
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY
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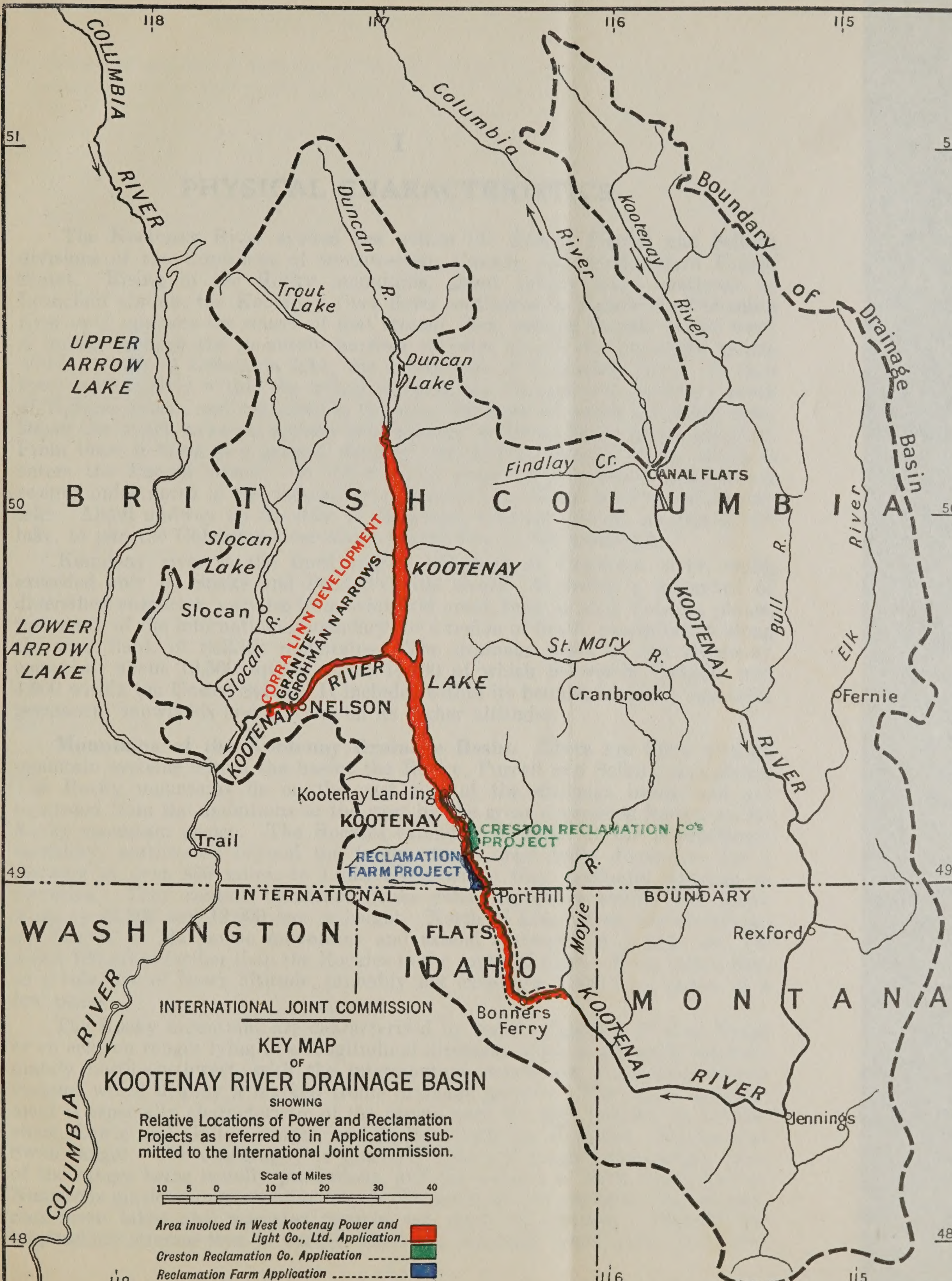
PREFACE

The Commission is indebted to officers of the Geological Survey of the United States, the Geological Survey of Canada, and the Dominion Water Power and Hydrometric Bureau of the Department of the Interior of Canada, for valuable assistance in the preparation of the earlier chapters of this report.

The complete record of public hearings in connection with the Applications of the Trustee in Bankruptcy of the Kootenay Valley Power and Development Company and the West Kootenay Power and Light Company has not been printed, but copies are on file in the offices of the Commission in Washington and Ottawa, as well as copies of all exhibits filed on behalf of the various interests at the hearings in these cases, as well as in that of the Creston Reclamation Company.

As stated elsewhere in this report, the summaries of Briefs filed on behalf of the Applicants and of the Governments of the United States and Canada have in each case been prepared under the direction of those who filed the original Briefs.



INTERNATIONAL JOINT COMMISSION
KEY MAP
OF
KOOTENAY RIVER DRAINAGE BASIN
SHOWING
Relative Locations of Power and Reclamation Projects as referred to in Applications submitted to the International Joint Commission.
Scale of Miles
10 5 0 10 20 30 40
Area involved in West Kootenay Power and Light Co., Ltd. Application
Creston Reclamation Co. Application
Reclamation Farm Application
BRITISH COLUMBIA
WASHINGTON
IDAHO
MONTANA
INTERNATIONAL BOUNDARY
Boundary of Drainage Basin
COLUMBIA RIVER
Columbia River
UPPER ARROW LAKE
LOWER ARROW LAKE
Duncan R.
Trout Lake
Duncan Lake
Slocan Lake
Slocan
Slocan R.
CORRA LINN DEVELOPMENT
GRANITE
GROHMAN NARROWS
KOOTENAY LAKE
KOOTENAY RIVER
NELSON
Kootenay Landing
KOOTENAY FLATS
CRESTON RECLAMATION Co's PROJECT
RECLAMATION FARM PROJECT
Trail
Port Hill
Bonners Ferry
Moyie R.
KOOTENAI RIVER
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Findlay Cr.
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St. Mary R.
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Fernie
Rexford
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I

PHYSICAL CHARACTERISTICS

The Kootenay River system lies within the Rocky, Purcell and Selkirk divisions of the Cordillera of southwestern Canada and northwestern United States. Rising in the Rocky mountains, about twenty miles southeast of Leanchoil station, the Kootenay river flows southeasterly parallel to Columbia river until opposite the source of that stream, then, turning sharply to the west, it breaks through the mountain barriers to enter the Rocky mountain trench within a mile of Columbia lake, the headwaters of Columbia river. It then flows southeasterly within the trench, crossing the international boundary north of Tobacco plains, and continues in the same direction for about ten miles, then, leaves the trench to sweep around southwesterly as far as Fisher Creek junction. From there it flows in a general westerly direction to Bonners Ferry, where it enters the Purcell trench. It follows this trench northwesterly until about twenty miles north of the international boundary to where it enters Kootenay lake. About midway up the lake, it discharges westerly through an arm of the lake, to join the Columbia river about twenty-five to the southwest.

Kootenay river is the third largest tributary of Columbia river, being exceeded only by Snake and Pend d'Oreille rivers. It drains a watershed of diversified character, varying from semi-arid areas, such as near Tobacco plains, just south of the international boundary, to a region of heavy precipitation along the west flank of Selkirk mountains. The drainage basin of the Kootenay comprises about 19,500 square miles, 14,600 of which lie within Canada, and 4,900 within the United States. It includes within its boundaries many extensive permanent snowfields and glaciers on its higher altitudes.

Mountains of the Kootenay Drainage Basin. There are three distinct mountain systems within the basin; the Rocky, Purcell and Selkirk mountains. The Rocky mountains lie on the east side of the drainage basin, and are separated from the mountains to the west by the great depression known as the Rocky mountain trench. The Rockies extend from south of the international boundary, northwards beyond the limits of the area under discussion, for a distance of over 850 miles, to Liard river, where they gradually decrease in elevation. They contain numerous peaks extending above timber-line, many rising to 10,000 and 12,000 feet in height. North of Liard river, the mountains are known as Mackenzie mountains and extend eastward, in a wide arc, for about 100 miles farther than the Rockies to the south of them. These mountains, as a rule, are of lesser altitude, probably not exceeding 7,000 feet, except in a few peaks.

The Rocky mountains are characterized by the development of long, linear or en echelon ranges lying in a longitudinal direction which is generally approximately north-northwest, with the intermontane depressions containing stream systems which display a marked trellis drainage pattern. This linear arrangement is especially characteristic of the ranges near the 49th parallel, in Livingstone, Lewis and Galton ranges, and farther south by Kootenai, Mission and Swan ranges. The topography is generally bold and rugged, the eastern faces of the ranges being usually precipitous, and the western or back slopes less so. Numerous glaciers and extensive snowfields nestle on the summits; and cirques, rock-basin lakes and glaciated troughs are much in evidence. Whereas the longitudinal streams flow in valleys which are generally broad with flat valley-

floors, the transverse streams where they break through the ranges flow in much narrower valleys, with rapids, falls and canyons along their courses, especially near their entrance to the major valleys.

The Lewis range is the front range of Rocky mountains in northern Montana and southern Alberta. A short distance to the west and closely related to it is the parallel Livingstone range. Both ranges have craggy peaks intricately carved by alpine glaciation. Their altitudes are about 8,000 to 10,000 feet, the peaks being separated by passes or cols ranging from 5,500 to 6,500 feet above sea-level.

The eastern margin of Lewis range rises abruptly above the plains or foot-hills with east-facing escarpments of extraordinary height, which are the walls of vast cirques, usually occupied by small mountain tarns.

To the west of Livingstone range is the wide, open valley of Flathead river, which is the dividing line between that range and McDonald and Galton ranges. These ranges, linear in alignment, like the more easterly ones, have much less rugged topography, with their accordant summit levels mostly below timber-line. Part of the difference in ruggedness is due to rock structure, and part to difference in elevation. The eastern ranges have a greater contrast of hard and soft rock structure, and also have had more extensive glacial sculpturing due to their higher altitude.

North of the 49th parallel, the linear arrangement of the Rockies continues, but near Highwood river the trend turns more to the northwest. It is noticeable that, in many places along the Rocky mountain front, wherever a major stream breaks through the mountain ranges there is a change of directional trend north of the river. This may be due to the fact that in these places there is a crushed zone or faulting, and the rivers have chosen these positions where erosion was the easiest. Livingstone range continues northerly to Highwood river, beyond which the range is called Highwood range locally. North of Highwood range, the linear arrangement of the mountains is somewhat broken by the easterly offset of Moose mountain outlier, and by several transverse streams. The succeeding ranges to the west are Highrock and Elk ranges, which form the continental divide, the water from their western slopes draining into Elk river and other streams of the Kootenay river drainage basin. North of Elk mountains there are several ranges which maintain their linear habit, but are offset and separated by transverse streams. On the west, bordering the Rocky mountain trench, are the Beaverfoot, Brisco and Stanford ranges, which are here the west flanking ranges of the Rocky mountain system. Beaverfoot range has a general elevation of 8,500 feet and is separated from the more easterly mountains by a broad, through valley which contains the north-flowing Beaverfoot and the south-flowing Kootenay rivers. The divide between the two streams is so low and flat that no slope is observed. It is probable that the waters of upper Kickinghorse river flowed through this pass in a time not very remote, and that by a manner of piracy the lower Kickinghorse river has tapped the system and diverted the upper Kickinghorse and Beaverfoot drainage to its present course. Glacial scouring and damming may have been contributory factors also.

Between Stanford and Hughes ranges and the continental divide is a high rugged area less well known than other parts of the southern Rockies of Canada, which contain high craggy mountains, rising from 9,000 to 10,000 feet above sea level, with many snowfields and glaciers which supply water to several tributaries of the Kootenay.

Purcell Mountains. The Purcell mountains lie west of the Rocky mountain trench. Their western limit is the Purcell trench which joins the Rocky mountain trench near Beaver. The rest of the boundary is the valley of

Kootenay river from Gateway, where the river leaves the Rocky mountain trench and swings around south and west to Bonners Ferry, Idaho, where it enters the Purcell trench.

The southern part of the Purcells is divided into three ranges, McGillivray, Yahk and Moyie, by the Yahk and Moyie rivers. The uniformity of the topography of these ranges is a reflection of the uniformity of the underlying rocks. They generally have a marked accordance of summit levels, with occasional peaks projecting above the general level, especially around the basin of Yahk river. Their maximum elevation is about 7,500 feet. Being thus below timber-line, they are uniformly clothed with a forest covering, except for a few peaks not reduced below the general level. Farther north, opposite Windermere lake, at the headwaters of Toby and Horsethief creeks, altitudes of over 11,000 feet are attained, and the summit become more rugged, with attendant alpine glacial features. Many glaciers supply water to the headwaters of several important tributaries of the Kootenay river system. The lower slopes of the ranges are well timbered, especially those adjacent to the main trench.

In their northern limits, the most important streams of the Purcells drain into the Columbia river system, as the divide is much closer to that stream. North of the Duncan-Beaver divide all the drainage is into the Columbia and its tributaries.

Selkirk Mountains. The Selkirk mountains include a series of ranges bounded on the east by Purcell trench, on the northeast and north by a portion of Rocky mountain trench, on the west by Selkirk valley, and on the south by Columbia lava plain, a detached group of low granite hills west of Pend d'Oreille lake and the cross valley from Pend d'Oreille lake to Bonners Ferry which contains Pack river and Sand creek.

In the south, the chief ranges are Nelson and Bonnington ranges separated by Salmon river; and the Pend d'Oreille mountains lying between Pend d'Oreille river and Colville river; and Colville mountains between Colville river and Columbia lava plain. North of these are Valhalla mountains between lower Arrow Lake and Slocan river, and Slocan mountains between Lardeau river and upper Arrow lake and Slocan river. North of here to the big bend of Columbia river are numerous ranges, few of which have been named.

In general the southern ranges show an accordance of summit levels and are mostly below timber-line, but north of Kootenay river rugged topography prevails, with numerous peaks over 9,000 feet, and several attaining 10,000 feet and over. Although the summits were not covered with the Cordilleran glaciers, alpine glaciers and glacial features are prevalent, especially to the north, and have left their impression on the character of the peaks and river valleys.

Major Trenches. Within the Kootenay river drainage system, there are three major valleys called trenches. The largest and probably the greatest of its kind in the world is Rocky mountain trench. It is a great longitudinal depression, being unique for its remarkable persistence. Whatever its past history may have been, it has now no single drainage system, but is drained by rivers belonging to several distinct systems.

It extends northwestwards from Flathead lake, in Montana, to the Yukon system in the north, and is drained by different systems which flow in alternate directions. At the south, Stillwater river drains south to Flathead lake, then Tobacco river drains north to meet the south-flowing Kootenay. North of this is the north-flowing Columbia, the south-flowing Canoe and the Upper Fraser which flows north. As far as about latitude 54, the trench is readily definable, but near the great bend of Fraser river, the mountains west

of the river die away, and it is not improbable that the trench extends en echelon slightly to the east by way of Clearwater and McGregor rivers, and thence northwestwards by the valleys of the Parsnip and Findlay rivers of Peace river system, and the Katchika and Frances of the Liard system, followed to the north by the Pelly of the Yukon system.

At its southern end, south of Flathead lake, in Montana, with a different character, there is a depression running south for over 150 miles containing the Flathead and Bitterroot rivers. This may also be considered as part of the Rocky mountain trench.

The remarkably straight floor of the trench varies in width from two to twenty miles, with occasional wider areas. Near Cranbrook, this intermontane depression attains a maximum width of about twenty miles, and consists of a beautiful expanse of park-like country, with open meadows dotted with lakes and the Kootenay river meandering through it. For the most part its bordering benches lie about 300 feet above the low bottom land which rarely exceeds a mile in width.

The eastern border of the trench is the Rocky mountains, which rise abruptly from the valley floor, while on the west of the trench, more gentle slopes rise to the rounded summits of the lower Purcells, which in turn give way to more rugged topography.

Purcell Trench. The next major trench to the west is Purcell trench which separates the Purcell and Cabinet mountains from the Selkirk system. Its southern extremity is at the south end of Cœur d'Alène lake, about eighty miles south of Bonners Ferry, Idaho, where it is occupied by Pend d'Oreille lake, Pack river, Sand creek and the part of Kootenay river that returns northerly into Canada, after its great loop west from Jennings, Montana. North of this, it is occupied by Kootenay lake for about seventy miles, and by the Duncan river, north of which is the north-flowing Beaver to the confluence with Columbia river. Here the trench joints the Rocky mountain trench with an acute barb.

At the south, the depression is bounded by low rounded hills capped with basalt. North of Cœur d'Alène lake, the trench is bordered irregularly by low hills, and it is only at Pend d'Oreille lake that the trench characteristics are assumed, although no major stream occupies that part of the valley, until at Bonners Ferry where the Kootenay enters from the southeast. In the portion between Pend d'Oreille lake and Bonners Ferry, the valley floor is wide and flat, but is only occupied by the minor streams of Pack river and Sand creek.

The bordering mountains rise steeply from the floor of the valley to heights of 7,000 and 8,000 feet above sea level. The tributary streams flow in valleys which do not enter at grade, but usually have a series of cascades or falls near their confluence with the main stream.

It is believed that the Purcell trench is of a more ancient date than the Rocky mountain trench, having been eroded by a stream which existed in Tertiary times. The valley was later widened and deepened by the great Cordilleran glaciers, which smoothed off the inter-stream spurs, and deepened the main valley below the level of its tributary streams, thus leaving the side valleys "hanging". The rapids and falls of the tributary streams, near their junction with the main trench, are due to this "hanging" effect.

Selkirk Valley. The third great trench is known as Selkirk valley, and is occupied by the south-flowing Columbia river. Its southern end is about sixty miles south of the International boundary, and its northern extremity near the 52nd parallel, where the valley joins the Rocky mountain trench with a similar barb as the Purcell trench. It is a wide valley, and, in places, is occupied by deep, narrow lake expansions, such as the Upper and Lower Arrow lakes.

Kootenay River Drainage System. For purposes of description, the Kootenay river drainage system may be divided into three parts: the upper part of the main stream and its tributaries which lie between the Rocky mountains and the Selkirks; the part tributary to Kootenay lake; and the transverse valley from Kootenay lake to Columbia river.

The first division occupies several distinct valleys. In its upper reaches, it flows in a valley parallel to the Rocky mountain trench, with Brisco range between it and the Columbia river, until opposite Columbia lake, where it turns westerly across the mountain ranges between Brisco and Stanford ranges, to enter the Rocky mountain trench, which it then follows southerly. Along its upper course it lies along the base of the continental divide, where the mountains rise abruptly to elevations of from 9,000 to 12,000 feet. The general elevation of this part of the Kootenay river before it enters the Rocky mountain trench is 3,400 feet. It enters the trench about a mile south of Columbia lake, with an elevation about 16 feet above the lake, which lies 2,652 feet above sea-level. At the point of entry, it is a stream about 900 feet wide, and flows across a flood plain, the borders of which are only about three feet above the level of the stream at flood. At one flood season, however, the river has been known to have sent part of its water northerly into Columbia lake.

The eastern boundary of the valley is the Rocky mountain system, distant about two to four miles from the river and rising abruptly from the flat bench land. To the west of the trench are the Purcell mountains which, as a rule, ascend more gradually and to somewhat lesser heights than the Rockies. On both sides of the river, the mountains are penetrated deeply by lateral valleys, in which flow the important tributaries of Kootenay river. They occupy deep, narrow valleys and follow winding courses among the Rockies and Purcells. Many power sites are found in the valleys, some of which have been developed for mining and other industrial purposes.

Tributaries of Kootenay River. Along its upper course, the Kootenay is joined by several tributaries. The most northerly one of any size is Vermilion river, along which the Banff-Windermere highway is located. It rises near Boom mountain on the continental divide, and flows southerly until opposite Vermilion pass, which has an altitude of 5,376 feet. It then turns and crosses through the westerly ranges to enter a broad, longitudinal valley in line with the upper Ottertail river. It follows this linear valley southeasterly for about twenty miles, where it again turns westerly through the ranges to join the Kootenay, having a descent of over 1,500 feet in its course.

Cross River. Cross river rises near White Man pass, which is 7,112 feet above sea-level, and flows directly across the strike of the western ranges, being joined in its course by a large tributary, the Mitchell river. Mitchell river for the most part occupies a longitudinal valley, and has two tributaries, one rising under Marvel pass, altitude 7,050, and the other in Sunburst valley, about 7,200 feet above sea-level

For the last three-quarters of a mile above its confluence with the Kootenay river, Cross river flows in a canyon 160 feet deep with almost perpendicular sides. There are three falls in this part, and in places the canyon is 60 feet deep and barely ten feet across at the top.

Palliser River. Palliser river has a drainage basin of about 270 square miles. It rises north of mount Back at the divide between its waters and Spray river. After flowing southerly in a wide valley for about ten miles, it swings westerly across the ranges in a more restricted valley, being joined in its course by several tributaries, the largest of which is Albert river. Albert river heads north of the Royal Group of mountains at Spray pass, which has an elevation of 6,275 feet. Near its junction with the Kootenay, Palliser river has several falls.

About 19 miles up from the junction there is a fall of 52 feet, with a total descent of 104 feet in about 2,000 feet. Below the fall for about 1,500 feet, there is a narrow canyon with sheer walls only 20 feet apart. Eight miles from its mouth, there is another fall of about 30 feet, and a half-mile from the confluence there is another descent of 175 feet in about 4,500 feet, with a deep canyon below the main fall. The elevation at the mouth of the Palliser is approximately 3,125 feet above sea-level.

White River. White river has its source under Mount Joffre at the Sylvan pass. It follows the same habit as the other tributaries, flowing southerly for several miles, then cutting transversely across the ranges to the west, but before entering Kootenay river, it follows a valley parallel with that stream and flows northerly for some twenty miles. Its elevation at its confluence with the Kootenay is about 2,930 feet.

Bull River. Bull river, about forty miles long, rises within the Rocky mountains just north of 50 degrees latitude. It flows for eight or ten miles through a canyon about 50 to 100 feet wide, but near its junction with Kootenay river, this is restricted to a width of about 15 feet at its top, and the river drops 175 feet in the last 400 feet.

Elk River. The largest tributary from the east is Elk river. It rises in the Rockies under Mts. Abruzzi and Cadorna and flows southerly in a longitudinal valley for about 65 miles, then flows in a southwesterly direction for about 50 miles to join Kootenay river south of Waldo. In its upper reaches it is joined by Fording river which heads in a series of cirques along the west flank of Highrock range. Just before entering Elk river there is a fall within a narrow canyon. As is the habit with most of these tributaries, this fall occurs where the stream breaks through its western barriers. The elevation of Elk river at its point of entry into the Kootenay is 2,394 feet.

St. Mary River. The most important tributary on the west side of the upper Kootenay river is St. Mary river which enters at Fort Steele. In the upper parts of their courses, the tributaries of St. Mary river flow in broad U-shaped valleys, but near their confluence with the main stream, the valleys become narrow canyons through which the river flows with a series of rapids or falls of from fifty to seventy-five feet in height, then with lower gradients they enter the St. Mary valley through gravel banks about fifty feet high. This "hanging" habit is general with nearly all the tributaries of this stream.

The main St. Mary meanders widely over a broad valley floor with abrupt walls rising to 4,000 or 5,000 feet then gently sloping back to the upland surface. As Kootenay valley is approached, terraces are noticeable and the river flows over a floor cut in stratified drift and gravel.

Yahk River. Yahk river has its source in several tributaries rising just north of the international boundary, in a rugged country about 7,000 feet in altitude. It flows a little west of south to join the main Kootenay river a short distance east of the Montana-Idaho boundary.

Moyie River. Moyie river rises in the Purcells southwest of Cranbrook. In its upper reaches it flows easterly in a broad, mature trough then plunges over a fall of about 75 feet into a narrow gorge cut through gravels and bedrock, for about 200 feet below the general level of the floor of the valley. Then turning sharply, it flows through a narrow valley for three miles, to again enter the wide, mature valley, in which lies Moyie lake. The lake is surrounded by a series of benches up to about 270 feet above the lake. The river, on leaving the lake, flows southwesterly between the Yahk and Moyie mountains and joins the Kootenay river about eight miles east of Bonners Ferry.

Kootenay River. South of Gateway, the Kootenay river leaves the main Rocky mountain trench in which it flows south of Columbia lake, and begins to swing southwesterly as far as Jennings, Montana, then, turning, it pursues a northwesterly course between Purcell and Cabinet mountains to Bonners Ferry where it enters the next major valley, the Purcell trench. Between its two major trenches, the river assumes a different character. It is a swift-flowing river, confined between steep, rock banks which rise to a broad terrace, generally several hundred feet above the river. Between Libby and Troy, there is a deep canyon with a cataract midway along its course. Here the mountains rise almost sheer for several thousand feet. Where the longitudinal valleys join this part of Kootenay river, there are wide flats which provide excellent places for townsites especially at Libby and Troy. On entering the Purcell trench, the river again assumes its widely meandering habit.

Kootenay Lake and Its Tributaries. Kootenay lake, 1,735 feet above sea-level, is about 70 miles long and two to three miles wide and has a remarkable depth. Down the middle of the lake, and to within a short distance of the shore, its floor is almost flat and is from 380 to 395 feet below the surface of the lake. On either side of this floor, the sides rise steeply. Glacial accumulations and an alluvium veneer may account for its remarkable flatness.

About midway up Kootenay lake, an arm extends westerly, forming an outlet for the lake. The lake is hemmed in by mountains which reach an altitude of about 7,000 to 9,000 feet. The watershed divide being close to the lake, the tributaries are short with steep gradients. There is little bench land, as the mountains generally rise directly from the water's edge. At the mouths of most of the streams draining into the lake, there are deltas of considerable size, and at the upper end of the lake an alluvial flat extends northerly for approximately five miles, with a width of about two miles.

The lake has an average variation in water level of 19 feet, but in abnormal seasons it has been known to rise 32 feet. Kootenay river enters the lake at its southern end with a series of broad meanders among saucer lakes, and its flood plain is subject to much overflow in this section. It debouches westwards towards the Columbia river from the end of the west arm of the lake, which has a perceptible current throughout its length.

Duncan and Lardeau Rivers. The main tributaries entering Kootenay lake are the Duncan and Lardeau rivers at its northern end. Duncan river enters the lake over a broad alluvial plain. Its valley runs a little west of north for about sixty-five miles. The same depression continues with the same directional trend to near Beavermouth and is occupied by Beaver river of the Columbia drainage system.

About three miles from Kootenay lake, the valley of the Duncan branches, and Lardeau river enters through the westerly trough. For several miles, between the two rivers there is a very low ridge. The valley of Duncan river is about a mile wide, with low gradient and expands into Duncan lake about eight miles to the north. The lake is about 75 feet above the mean level of Kootenay lake. The valley is broadly U-shaped, and most of the tributaries are short, entering the main valley with falls and rapids near their mouth.

Lardeau river occupies a trough extending northwesterly from Duncan river to beyond Trout lake, from where a very low pass leads to Beaton river and the head of Upper Arrow lake. Trout lake is narrow and about eighteen miles long, with a remarkable depth. In places it is from 700 to 765 feet deep; and about 96 feet at its lower end, where the Lardeau river issues through a narrow, rock channel. Most of the tributaries of Lardeau river debouch from hanging valleys, through canyons into the main trough. The rapids and falls of these tributaries are potential power sites for local purposes. The valleys

dissect the country into a number of ranges with northwest-southeast trend, aligned with the prevailing rock structure. The mountains at their headwaters are some of the most rugged of the Selkirks, rising to 11,000 feet in places, with perpetual snowfields and glaciers for supplying water to the streams.

Kootenay River. The third section of Kootenay river is that part from the west arm of Kootenay lake to the confluence of the river with the Columbia. On leaving the lake, the river runs westerly through the Selkirk mountains to join the broad valley of the Columbia at Castlegar. The transverse valley through which it flows is the site of magnificent waterpowers. The valley is much narrower than the longitudinal valleys of the rest of the Kootenay drainage system, and it contains the most important rapids and falls of the entire drainage basin, the chief of which are Upper and Lower Bonnington falls. The river drops 330 feet in 20 miles through a narrow channel generally cut in solid rock where damming is easy from an engineering standpoint.

Slocan River. The main tributary of this section of Kootenay river is Slocan river which has a length of about 55 miles, rising in Slocan and Summit lakes. Slocan lake has a length of about 25 miles, with an elevation of 1,761 feet above sea level. The river is rapid and is bounded by mountains rising to 6,000 and 7,000 feet with occasional peaks of 9,000.

Slocan Lake. Slocan lake is very narrow and deep. It deepens from north to south, having a depth of 830 feet opposite New Denver, and about 927 feet near its southern end.

Summit Lake. From Summit lake, a pass leads through to Nakusp creek which drains into lower Arrow lake. The pass and creek are aligned in the same direction as the upper half of Slocan lake and follows the trend of the underlying rock structure. The southern part of the lake is coincident with the foliation of the rocks and a crushed zone within the granites.

Critical Elevations within the Kootenay Drainage Basin. Critical elevations within the Kootenay Drainage basin:—

Confluence with Columbia river..............	1,380 L.W.
Confluence with Slocan river.................	1,493
Confluence with Kootenay lake..............	1,749 L.W.
Confluence with Elk river......................	2,349
Near mouth of White river..................	2,930
Three miles above mouth of Palliser river....	3,150
Summit lake, Slocan river..................	2,490
Trout lake..............................	2,347
Columbia lake............................	2,652

Drainage Area. Supplementing the above description of the physical characteristics of the Kootenay Valley in British Columbia and Idaho, the following paragraphs are taken from the Statement Relative to the Application of the West Kootenay Power and Light Company, prepared by the United States Geological Survey, 1929: "The drainage area of the Kootenai river includes one of the very mountainous regions of North America. For 175 miles its watershed line follows the Continental Divide as interposed by the Canadian Rockies. It embraces a considerable portion of the western slope of this notable mountain system and the southern part of the Selkirk mountains. The altitudes of these mountains exceed 10,000 feet at many points and a large area is above 5,000 feet. The length of the Kootenai river in the general direction of its course is about 400 miles. It rises in British Columbia, flows southward for about 150 miles to the Montana line, flows for the next

150 miles or thereabout through northwestern Montana and northeastern Idaho, makes a long bend back to the north, re-enters British Columbia, and in a distance of a little less than 100 miles joins the Columbia 30 miles north of the international boundary. The area of the Kootenai river basin is 19,450 square miles, of which three-fourths is in Canada and one-fourth in the United States.

"The basin of the Kootenai river lies 400 miles inland from the Pacific ocean, beyond high mountain ranges. Although the climate of the basin has continental characteristics its relative mildness as compared with that of similar latitudes farther east indicates that the Pacific ocean is influential in some measure thus far inland. Climatic conditions vary considerably within the basin because of the modifying effect of the high mountains. The mean annual temperature in the Kootenai Valley is about 44° and in other places in the basin it is generally within the limits of 40° and 46°. Winter temperatures rather frequently fall below zero and summer temperatures sometimes reach 100°. The average length of the period between killing frosts is about four and one-half months, but in many places it is shorter in varying degrees. These statements as to temperature apply generally to observations made at valley stations. In the mountains, conditions are undoubtedly more rigorous. The annual precipitation ranges from less than 17 inches at certain places in the valley to probably more than 70 inches at the higher altitudes. Apparently somewhat more than half the precipitation occurs in the six months from October to March and, especially in the mountains, is very largely in the form of snow, which tends to accumulate throughout the winter until warm spring days arrive to melt it.

"Unlike many streams elsewhere in the country, the flow of Kootenai river follows a pronounced annual cycle of flow marked by considerable regularity. The highest waters of the year are caused by the melting of the accumulated snow in the high mountains. Usually the river becomes very low during the winter, but as spring approaches the accessions from the thawing snow cause it to rise more or less gradually, begining in April, until the maximum flow is reached, generally in late May or June, the exact time depending upon the cumulative influence of weather conditions. Thereafter the general trend of the flow is to become steadily less until the end of the summer, when low-water conditions are again reached, to continue with relatively minor fluctuations until the following spring.

"The Kootenai river is the third largest tributary of the Columbia river. It discharges three times the flow of the Mississippi river at St. Paul, or of the Potomac river at Great Falls and five times the flow of the Merrimack river at Lawrence, Mass.

"The basin includes valuable mineral and timber resources, and there is notable agricultural development in the alluvial bottoms of the narrow valleys and along their margins. The region is served by transcontinental railroad systems and a number of busy towns have grown up, notably Nelson, Creston, and Cranbrook in British Columbia; Bonners Ferry in Idaho and Libby and Rexford in Montana.

"About 18 miles north of the point where the Kootenai river returns to Canada (28 miles by river) it enters Kootenai lake, a body of water about 65 miles long, 2 to 5 miles wide, covering an area estimated roughly at 180 square miles. Through this stretch in Canada and extending up-stream to the vicinity of Bonners Ferry, Idaho, an additional distance of about 50 miles by river, the channel traverses an area which it seems likely was largely occupied by the lake in former ages but which has been gradually filled in by alluvial material brought down by the river and deposited in the manner that deltas are formed. A short distance above Bonners Ferry the valley is much narrower and the gradient of the stream is much steeper."

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II

HISTORY OF REGION

The first white man to stand on the banks of the Kootenay river was David Thompson, who for many years carried out exploration on behalf of the North West Company. He had entered the service of the Hudson's Bay Company in 1784, left them to join the North West Company in 1797, retired from the service in 1812, and from 1816 to 1826 was engaged in surveying and defining the international boundary between Canada and the United States. Between the years 1807 and 1811 he explored the entire system of the Kootenay and Columbia rivers from source to mouth. Thompson was, says Dr. J. B. Tyrrell, himself a famous Canadian explorer, "the greatest land geographer who ever lived. With extraordinary accuracy he placed on the map the main routes of natural travel in one million two hundred thousand square miles of Canada and five hundred thousand square miles of the United States. Study of his journals shows that on foot, by canoe, and on horseback he covered fifty-five thousand miles."

Thompson on the Columbia. In the *Narrative of His Explorations in Western America* 1784-1812, edited by J. B. Tyrrell and published by the Champlain Society in 1916, Thompson says: "I believe that I have said enough about the country on the east side of the mountains; I shall therefore turn to the west side. I have already related how the Peagans (Blackfeet) watched us to prevent our crossing the mountains and arming the Natives on that side; in which for a time they succeeded, and we abandoned the trading post near the mountains in the spring of 1807. The murder of two Peagan Indians by Captain Lewis of the United States, drew the Peagans to the Mississouri to revenge their deaths; and thus gave me an opportunity to cross the mountains by the defiles of the Saskatchewan river, which led to the headwaters of the Columbia river, and we there builded Log Houses and strongly stockaded it on three sides, the other side resting on the steep bank of the river. The logs of the House, and the Stockades, Bastions, etc., were of a peculiar kind of a heavy resinous fir, of a rough, black bark."

Mr. T. C. Elliott, of Walla Walla, Washington, who was associated with Dr. Tyrrell in editing the book, in his foot-notes comments upon this passage in Thompson's *Narrative*. What is here described as the murder of two Peagan Indians refers, he says, to an attack upon Capt. Meriwether Lewis, of the Lewis and Clark Expedition by the Blackfeet at Marias river, Montana, on July 27, 1806, when Lewis killed a couple of Indians.

Kootenay House. The log houses referred to by Thompson were what was afterwards known at Kootenay House, the first trading post of the North West Company on the Columbia, and "ante-dating the first erected by an American trader, that of Andrew Henry on the headwaters of the Snake river, by more than three years. Simon Fraser had established trading posts on the Fraser river only the year before. Kootenay House was known to the North West Company officers east of the mountains as "Old Fort Kootenae" to distinguish it from other posts established on the Kootenay river, south of the 49th parallel of latitude, one near Bonner's Ferry, Idaho, which is noted on Thompson's map, and a later one opposite Jennings, Montana."

Thompson, having crossed the Rocky mountains by what is known as Howse pass, had now reached the banks of the Columbia, or more precisely lake

Windermere, near its source. The following year (1808) he travelled south crossing the mile or two of low-lying land that separates the source of the Columbia from the Kootenay. This land was afterwards known as Canal flats. He says in his *Narrative:* "I left the Kootanae House on the 20th of April, proceeded to the lakes, the sources of the Columbia river, carried everything about two miles across a fine plain to McGillivray's river, on which we embarked and proceeded down to look for Indians." What Thompson here calls McGillivray's river was the Kootenay. To add to the confusion, Thompson first named the Columbia the Kootanae. He proceeded down the Kootenay and finally reached Kootenay lake. "The navigation of the river" he says "was very dangerous from violent eddies and whirlpools, which threatened us with sure destruction, and which we escaped by hard paddling, keeping the middle of the river."

Thompson and the Piegans. Thompson tells a dramatic story illustrating the relations between the fur-traders and the Indians at this period.

"In my new dwelling," he says, "I remained quiet hunting the wild horses, fishing, and examining the country. Two canoes of goods arrived for trade on horses by the defiles of the Saskatchewan river. Half of these goods under the charge of Mr. Finan McDonald I sent to make a trading post at a considerable length in McGillivray's river (Kootenay river). The season was late and no more could be done. About the middle of November two Peagans (Blackfeet) crossed the mountains on foot and came to the House to see how I was situated. I showed the strength of the stockades and bastions, and told them, I know you are come as spies, and intend to destroy us, but many of you will die before you do so. Go back to your countrymen and tell them so, which they did, and we remained quiet for the winter. I knew the danger of the place we were in, but could not help it. . . .

"I had now to prepare for a more serious visit from the Peagans who had met in council, and it was determined to send forty men under a secondary Chief to destroy the trading Post, and us with it. They came and pitched their tents close before the gate, which was well barred. I had six men with me, and ten guns, well loaded, the House was perforated with large augur holes, as well as the bastions. Thus they remained for three weeks without daring to attack us. We had a small stock of dried provisions which we made go as far as possible. They thought to make us suffer for want of water as the bank we were on was about 20 feet high and very steep, but at night, by a strong cord we quietly and gently let down two brass kettles each holding four gallons, and drew them up full, which was enough for us.

"They were at a loss what to do, for Kootanae Appee the War Chief, had publicly told the Chief of this party (which was formed against his advice) to remember he had men confided to his care, whom he must bring back; that he was sent to destroy his enemies, not to lose his Men. Finding us always on the watch, they did not think it proper to risk their lives. When at the end of three weeks they suddenly decamped, I thought it a ruse de guerre. I afterwards learned that some of them hunting saw some Kootanaes who were also hunting, and as what was done was an act of aggression, something like an act of war, they decamped to cross the mountains to join their own Tribe while all was well with them. The return of this party without success occasioned a strong sensation among the Peagans.

"The Civil Chief harangued them, and gave his advice to form a strong war party under Kootanae Appee the War Chief and directly to crush the white men and the natives on the west side of the mountains, before they became well armed. They have always been our slaves (prisoners) and now they will pretend to equal us; no, we must not suffer this, we must at once crush them. We know them to be desperate men, and we must destroy them, before they become too powerful for us. The War Chief coolly observed, I shall lead the battle according to the will of the Tribe, but we cannot smoke to the Great

Spirit for success, as we usually do. It is now about ten winters since we made peace with them. They have tented and hunted with us, and because they have guns and iron headed arrows, we must break our word of peace with them. We are now called upon to go to war with a people better armed than ourselves. Be it so, let the Warriors get ready. In ten nights I will call on them. The old, and the intelligent men, severely blamed the speech of the Civil Chief. They remarked, " the older he gets, the less sense he possesses. On the ninth night the War Chief made a short speech, to have each man to take full ten days of dried provisions, for we shall soon leave the country of the Bison, after which we must not fire a shot, or we shall be discovered.

" On the tenth night he made his final speech, and exhorting the Warriors and their Chiefs to have their Arms in good order, and not forget dried provisions, he named a place, there I shall be the morrow evening, and those who now march with me, there I shall wait for you five nights, and then march to cross the mountains. At the end of this time about three hundred warriors under three Chiefs assembled, and took their route across the mountains by the Stag river, and by the defiles of another river of the same name, came on the Columbia, about full twenty miles from me. As usual, by another pass of the Mountains, they sent two men to see the strength of the House. I showed them all round the place, and they staid that night.

" I plainly saw that a War Party was again formed, to be better conducted than the last, and I prepared Presents to avert it. The next morning two Kootenae Men arrived, their eyes glared on the Peagans like tigers, this was most fortunate. I told them to sit down and smoke which they did. I then called the two Peagans out and enquired of them which way they intended to return. They pointed to the northward. I told them to go to Kootenae Appee and his War Party, who were only a day's journey from us, and delivering to them the Presents I had made up, to be off directly, as I could not protect them, for you know you are on these lands as enemies. The presents were six feet of tobacco to the Chief, to be smoked among them, three feet with a fine pipe of red porphyry and an ornamented Pipe Stem; eighteen inches to each of the three Chiefs, and a small piece to each of themselves, and telling them they had no right to be in the Kootenae country, to haste away, for the Kootenaes would soon be here, and they will fight for their trading Post.

" In all that regarded the Peagans I chanced to be right, it was all guess-work. Intimately acquainted with the Indians, the Country and the seasons, I argued and acted on probabilities. I was afterwards informed that the two Peeagans went direct to the camp of the War Party, delivered the Presents and the Message and sat down, upon which the War Chief exclaimed, what can we do with this man, our women cannot mend a pair of shoes but he sees them, alluding to my astronomical observations. Then in a thoughtfull mood he laid the pipe and stem, with the several pieces of Tobacco on the ground and said, what is to be done with these? If we proceed, nothing of what is before us can be accepted.

" The eldest of the three Chiefs, wistfully eyeing the Tobacco, of which they had none at length said: You all know me, who I am and what I am. I have attacked tents; my knife could cut through them, and our enemies had no defence against us, and I am ready to do so again, but to go and fight against Logs of Wood that a ball cannot go through, and with people we cannot see and with whom we are at peace, is what I am averse to. I go no further. He then cut the end of the Tobacco, filled the red pipe, fitted the stem, and handed it to Kootanae Appee, saying it was not you that brought us here, but that foolish Sakatow (Civil Chief) who himself never goes to war. They all smoked, took the Tobacco, and returned, very much to the satisfaction of Kootanae Appee, my steady friend. Thus by the mercy of good Providence I averted this danger."

Timber. Thompson describes the timber that then grew along the banks of the Kootenay river: " In places are very fine woods of Larch, Red Fir, Alder, Plane, and other woods; of the Larch at five and a half feet above the ground, I measured one thirteen feet girth and one hundred fifty feet clean growth, and then a fine head. This is one of many hundreds. I could not help thinking what fine timber for the Navy exists in these forests, without a possibility of being brought to market. The other woods, fine Red Fir, Pine, Cypress, White Cedar, Poplars, Aspins, Alders, Plane and Willows ". In a foot-note it is suggested that what Thompson calls the Plane tree was probably the dwarf maple.

Kootenay Falls. At the Lower Dalles, now known as Kootenay Falls, in Lincoln county, Montana, " We had to carry everything on the right side, up a steep bank of rock, and among the debris of high rocks, apparently rude basalt, the slope to the river bank was at a high angle, and our rude path among loose fragments of rock was about three hundred feet above the River, the least slip would have been sure destruction, having carried about one mile, we came to a Brook where we put up for the night. Each trip over this one mile of debris took an hour and a quarter and cut our shoes to pieces. The banks of the brook were about two hundred feet in height, with a steep slope of debris to descend, with not a grain of sand, or earth, on them, to relieve our crippled feet. From the brook we had one mile to carry to the River, to which we descended by a gap in the Rocks; the River had steep banks of Rocks, and (was) only thirty yards in width; this space was full of violent eddies, which threatened us with destruction and wherever the river contracted the case was always the same, the current was swift, yet to look at the surface the eddies made it appear to move backward as much as forward; where the river is one hundred yards wide and upwards the current is smooth and safe."

Old Trail. Thompson returned from Kootenay lake to his trading post, laying up his canoe somewhere near Bonners Ferry, buying horses and riding north across the southern loop of the Kootenay river by the same trail that was used afterwards by Governor Simpson of the Hudson's Bay Company in 1841. Mr. Elliott adds that this trail later became the much-used line of travel by miners and pack-trains when gold was discovered in the Kootenay district in 1863-64. It followed the bench-lands north from Bonners Ferry and then turned northeast across " Sarvice Berry Hill " to the valley of the Moyie river, close to Curzon Junction on the Canadian Pacific railway; from there it ran along the Moyie river and thence across Joseph's Ferry (Cranbrook) to the Kootenay river below Fort Steele.

Thompson had now travelled in a canoe—a century and a quarter ago—from the upper waters of the Kootenay to Kootenay lake. There is no evidence that he ever explored the lower Kootenay from the lake to the discharge of the river into the Columbia, although he explored and surveyed the Columbia from source to mouth, and in September, 1811, mentions specifically that he had passed the mouth of the Kootenay.

Kootenay Indians. Before leaving Thompson it may be well to say something about the native inhabitants of the Kootenay Valley, among whom he was to spend several years and with whom his relations seem to have been most friendly. In *The Indians of Canada* by Diamond Jenness, of the National Museum of Canada, the following account is given of the Kootenay Indians:—

" The Kootenay, who were taller than most of the Indians of British Columbia, inhabited in the second half of the eighteenth century the northern part of the state of Idaho, and the southeastern corner of British Columbia between the Rocky mountains and the Selkirks from about latitude 49 degrees north to 52 degrees north. Even at that time they seem to have been divided

into two groups, the Upper Kootenay of the upper Columbia and upper Kootenay rivers, who continually crossed the mountains to hunt the buffalo on the prairies, and even attempted to reach the posts of the fur traders on the upper Saskatchewan; and the lower Kootenay of the lower Kootenay river, who spoke a slightly variant dialect and, being farther removed from the mountains, seldom joined in the buffalo hunt, but subsisted principally on fish. Both groups, as we know from their traditions and from the explicit statement of the explorer Thompson, lived on the eastern side of the Rockies during the earlier half of the century, but were driven westward by the Blackfoot. In dress, customs, and religion, they resembled the plains' tribes far more than they did the tribes of British Columbia, except perhaps certain bands of the Interior Salish. They had no clans or clan crests, no secret societies or masked dances, and no division into grades or castes. Their dress, like that of the plains' tribes, was entirely of skin, consisting of moccasins, leggings, a breech-cloth (for women, a tunic), and a shirt or jacket; their dwellings were conical tents covered with buffalo hide or rush mats; and their cooking utensils were vessels of birch bark. The Lower Kootenay made also water-tight baskets of split roots, an art they probably learned from the neighbouring Salish, for the bark canoes and dug-outs of both the Lower and the Upper Kootenay were indistinguishable from Interior Salish craft. Wood-carving, however, was almost unknown among them, and the realistic figures which they painted on their garments, their tents and even their persons, followed the style of painting among the plains' Indians, not the styles of the Pacific coast.

"Society was as simple among the Kootenay as among the migratory tribes of Eastern Canada. There was no chief governing the entire tribe, or either of its two divisions; but every band had its leader, who was supported by an informal council of the older men. One of his sons generally succeeded him, in spite of the fact that the Kootenay seem to have reckoned descent through the female line. For war, and for the annual buffalo hunt across the mountains, they followed the Salish custom of electing a special chief whose office terminated with the return of the expedition. Women and children captured in war (mainly from the Blackfoot) were kept as slaves, but treated mildly and sooner or later absorbed into the tribe.

"Of the social and religious life of the Kootenay we have no detailed account. We know that they were inveterate gamblers, that they practised polygamy, securing their wives by purchase, and that the women carried their babies on their backs in highly ornamented wooden cradles not unlike those used by the women of the plains. Both boys and girls underwent the usual seclusion at adolescence, the boys, and often the girls also, seeking through dreams the protection of guardian spirits. Medicine men, who exerted considerable influence in the different bands and often occupied larger tents than the other Indians, derived their status from the customary visions gained during prolonged fasts and ratified, perhaps by some public ceremony. The dead with their ornaments were buried in shallow holes amid rocks and boulders, sometimes so carelessly that the bodies were exposed to the air. In the firm conviction that the dead would one day return to life at lake Pend'Oreille, all the Kootenay bands assembled at that lake in certain winters to hold a religious festival; and every night on their outward and homeward marches the Indians danced around fires in honour of the sun-god. They worshipped the sun above all the multitude of supernatural beings with which they peopled the universe. Before every war expedition, they offered it prayers and tobacco smoke; and, to win its favour, some warriors even chopped off the joints of their first fingers, or, like certain plains' tribes, sacrificed pieces of flesh from their arms and breasts.

"The Kootenay have adjusted themselves to European domination more successfully than any other tribe in British Columbia; for the isolation of their

country prevented much settlement until the second half of the nineteenth century, when they had already taken to ranching and the raising of horses, an occupation that closely corresponded with their earlier pursuits. They have continued it ever since, although a certain number of the men find employment as guides for sportsmen and as labourers for white farmers and ranchers. To-day (1932) the Kootenay number around 1,050, of whom 501 were living in Canada in 1924, the remainder in the United States. Mooney estimated their number at about 1,200 before they came into contact with Europeans."

Trading Posts. Between 1807 and 1812 Thompson had established trading posts for the North West Company in what are now southeastern British Columbia and the northern part of Idaho. He was unquestionably the first white man who travelled through and left an account of these regions. In 1821 the Hudson's Bay Company, which had followed the North West Company across the Rocky mountains some years before, absorbed the rival organization, and thereafter the fur trade west of the mountains was controlled by the Hudson's Bay Company. The valley of the Kootenay did not, however, at any time enter very largely into the operations of the fur traders.

Settlement. The area of settlement as distinguished from the fur trade, in the country west of the mountains, dates from about the middle of the last century. In 1858 British Columbia was organized as a colony, Vancouver island at that time being a separate colony. In 1866 the Island and mainland were united and in 1871 British Columbia became a province of the Dominion of Canada. The gold rush of 1858-60 gave an enormous impetus to the development of the colony, and its entry into the Dominion brought with it the building of Canada's first transcontinental railway, the Canadian Pacific.

Meanwhile Washington had been set apart as a territory of the United States in 1859, extending at that time east to the Rocky mountains. In 1863 Idaho became a separate territory, took its present form five years later, and in 1890 became a state of the Union.

Northern Idaho. Turning to Idaho, in a book by Mr. Byron Defenbach entitled *Idaho*, something is said about the influence of the Hudson's Bay Company in the early history of the state. "Few Idaho people realize how thoroughly and completely this great foreign corporation dominated every activity of the Idaho country for more than twenty years. As long as fur was the principal industry, the Hudson's Bay monopolized it; when that business began to decline, the company went into other commercial lines; its long arm reached everywhere; its fingers were in everything."

Elsewhere Mr. Defenbach says: "The thoughtful student of Idaho history cannot but be impressed that most of the great movements in our progress had their inception in the north and developed southward. The discovery by Lewis, the Spalding mission with its first farming ventures, the discovery of gold, these all began north of Salmon river. As the activities of our life moved to the south, they took the centre of interest with them, leaving the north for the time being at least in oblivion. Much of the story of northern Idaho prior to 1860 never has been, never can be told. The section was dominated by the Hudson's Bay people even more than was the south, with the added difference that they had no important post in Idaho north of the Snake river plains. Business along the northern streams was carried on entirely from posts at Kootenai, Thompson Falls and Spokane, all outside our boundary."

Civil Government. Mr. Defenbach has this to say about the establishment of civil government in Northern Idaho: "The Legislature of 1864 created a county under the name of Kootenai; to include all of the territory north of

the forty-eighth parallel, with Senesquoteen the county seat. The act provided that whenever fifty citizens of the subdivision should meet and petition to that end, the country should be organized.

"At the same time a similar act was passed, provided for a county to be called 'Lahtoh,' to include the Panhandle north and west of Nez Perce and Shoshone counties to the forty-eighth parallel, with its county seat at Coeur d'Alene City. In 1867 Lahtoh county was wiped from the map, and its territory added to Kootenai. Fourteen years elapsed before the necessary fifty citizens could be mustered into an assembly, or signed to a petition to complete organization. In 1881 Kootenai was fully organized as the thirteenth of the now existing counties of Idaho, with its county seat tentatively located at Rathdrum."

De Smet. Going back again to earlier days, Mr. Defenbach notes that in 1842 the missionary Father De Smet built a rude log chapel where lake Coeur d'Alene turns into the Spokane river, near the site of the future Fort Sherman. The little church was intended only for temporary use and was abandoned in the fall of the same year. Father De Smet's name is in fact associated with all this country immediately east and west of the Rocky mountains from Idaho and Montana up north to Jasper Park. He was not only a devoted missionary but a most enthusiastic traveller.

Transportation. Coming then to transportation, Mr. Defenbach says: "In 1859 Captain John Mullan surveyed the road which afterwards bore his name. It first followed the east side of the lake, but in 1861 he changed his route, and, passing through the present city of Coeur d'Alene, went down the Spokane valley. Near the spot where the present highway, the Apple Way, crosses the stream, a ferry was maintained by Antoine Plante, a half-breed Flathead, whose place was a landmark constantly referred to in the writings of that time. The British Columbia gold rush of the early sixties crossed Plante's Ferry, then proceeding over the Wildhorse Trail by way of Rathdrum, Seneaquoteen and Bonner's Ferry. In the early seventies, a pony mail route through the country had a station on the ranch of Wesley Wood, hence known as 'Westwood,' near the present village of Rathdrum. In 1878 Fort Coeur d'Alene was built; in 1891 its name was changed to Fort Sherman."

Kootenai County. Of the later history of the county he says: "By 1880, Kootenai county had a population of 318, and organization was completed in October, 1881, at a meeting held at Westwood. Among the officials appointed by the Governor of the Territory were George Wonnacott, M. D. Wright, Henry Melder, and O. F. Canfield. The writer is of the opinion that this Canfield was the same individual who, as a boy, was among the survivors of the Whitman massacre in 1847 and who, in old age, was a resident of Clarkston, Washington.

"There was a long and bitter contest over the location of the county seat, in which Rathdrum finally won. When the State was admitted, there were 4,108 people in all the vast region known as Kootenai county. The building of the Great Northern Railroad in 1892 gave considerable impetus to settlement, which was again checked by the panic of 1893 and the high water and other depressing influences of the succeeding year.

"The Legislature of 1905 divided Kootenai into the counties of Lewis and Clark, but the act was declared unconstitutional. In 1907 Bonner county was cut off, and in 1915 Benewah was taken from the southern part of Kootenai, reducing the original old county to its present size, with Coeur d'Alene as the county seat."

Bonner. "Bonner became the twenty-third county in Idaho with Sandpoint as its County seat. Its most striking physical feature is lake Pend d'Oreille, the largest body of water in Idaho and the second largest fresh-water

lake in the Rocky mountain system. It was on the shores of this lake that David Thompson built Kullyspell House for the North West Company in 1809 —near the present town of Hope. In the sixties a pony express route was established between Rathdrum and the head of lake Pend d'Oreille, and in 1864 the steamer *Mary Moody* and two other boats were built at Seneaquoteen. These boats picked up mail at Steamboat Landing and transported it across the lake to a settlement about where Sandpoint now is, where it was again taken on horseback through the mountains to Missoula. The first settlers in the county date back to 1880; the Northern Pacific built through soon afterwards."

Boundary. "Boundary county was created by an Act of the Legislature in January, 1915. Its territory comprises the most northerly part of the State. It is bounded on the west by Washington and Bonner county, on the north by British Columbia, and on the east by Montana. Its county seat is the historic town of Bonners Ferry on the Kootenai river.

"The region comprised within this county was the home of the Kootenai Indians; now reduced to only a fraction of their former strength. The entire section was formerly a part of Kootenai county and still later of Bonner.

Wild Horse Trail. "The Canadian boundary line along the forty-ninth parallel was surveyed in 1858. A few years later the stampede to the gold discoveries in British Columbia began, and the 'Wild Horse Trail' from Walla Walla was followed by hundreds of eager prospectors, through Bonners Ferry and down the Kootenai river. The trail crossed the stream at about the site of the present Bonners Ferry, the travellers being taken across in canoes by Chief Abraham and other natives. In 1864 E. L. Bonner and his associates bought the rights to this crossing from the Indians, and the following year were granted a licence by the Idaho Territorial Legislature to operate a ferry. Bonner became a prominent character in the country, and later made his headquarters at Missoula, Montana.

"In 1875 Richard Fry bought Bonner's rights, and for many years conducted a trading post in connection with his ferry. In later years the ferry was purchased by Malcolm Bruce, and was sold to Kootenai County in 1902. Between the years 1875 and 1884 the Fry brothers and their families were the only persons of white blood in what is now Boundary county.

Bonners Ferry. "Bonners Ferry, formerly known as Bonners Port, and for a time as Eatonville, is located near the site of the Wild Horse Ferry on the Kootenai river. The trail from Walla Walla to the British Columbia mines reached the present Idaho by way of the Mullan road at the Antoine Plante Ferry across the Spokane river, near the point where that stream enters the present state of Washington. It then proceeded to the northeast by way of La Clede and Sandpoint to the Kootenai river.

"The Fry brothers came to the county in 1875, and in 1884 a man named Stone, with his family settled in the valley about three miles below the present town.

"After the completion of the Northern Pacific Railroad in 1882, Kootenai station became the supply point for the north, and in 1885 a toll road was built by Doctor Hendricks from that station to Bonners Ferry. At the latter point a trail led down the Kootenai river, and there was also considerable steamer traffic. In 1888 William Eaton established a general store; in 1892 the Great Northern reached the town, and the old toll road was practically abandoned.

"Among the names connected with the early history of Bonners Ferry are those of Captain George R. Gray, Henry Melder, W. L. Kinnear, Bartlett Sinclair and James E. Dolan. With the advent of the railroad, Chinese to the number of fifty established themselves in the town, but in 1892 were compelled to leave.

"Half of the business part of the town was destroyed by fire in 1893, and the following year most of the townsite was flooded and some of its buildings washed away. Other years of high water were 1898, 1903 and 1916, but the flood of 1894 still holds the record.

"The first school in Bonners Ferry was taught by Mrs. Martin Fry in the winter of 1883-84; she had ten pupils, among whom her own children were the only whites.

"The population of Bonners Ferry in 1920 was 1,236, and in 1930, 1,418."

Dewdney Trail. Returning to British Columbia, before describing the development of mining it may be well to say something about the attempts to open up this part of the country by construction of practicable roads. The Dewdney trail was explored by Edgar Dewdney in 1865. It roughly paralleled the international boundary and finally reached the Kootenay and Big Bend country.

Dale L. Pitt in a paper "What Mining has done for British Columbia," published in the Transactions of the Canadian Institute of Mining and Metallurgy for 1932, says that the Dewdney trail "was built primarily to provide a route entirely in British Columbia over which gold could be brought to Victoria. Some used part of this trail to go by way of Similkameen, Nicola and Kamloops or into the Cariboo, but it was not suitable for traffic of any proportion.

"Water transportation to Yale was satisfactory, so it was a question of a suitable route from there. Two routes were finally used: first, by way of Harrison lake, Douglas and Lillooet, and later by the famous Yale-Cariboo route up the Fraser via Spences Bridge and Lillooet. Time does not permit the detailing of the construction and early uses of these roads or of their extensions as new cities grew up around the many mining operations. Suffice it to say that these became the main arteries of travel and are to-day the backbone of our provincial highway system.

"So, at this juncture, we can credit to mining another very important, far-reaching, and decidedly beneficial role—namely, the beginning of the road system of British Columbia—and it is quite conservative, I believe, to here state that the mines and mining have ever since been the fundamental and most important factor in this road-building program. Around the mines have been built the majority of the cities of this province, and to reach these cities the roads have to be built."

Elsewhere Mr. Pitt says: "The young province could not see all of its trade going into the United States, and so Royal Engineers set out to find a route from Victoria to the new country. The route up the Fraser to Lytton, thence up the Thompson to Kamloops, up the South Thompson, Shuswap lake, and over the divide to the Columbia, was followed and proposed as feasible. It was too expensive, however, to the struggling province. It is significant, nevertheless, that this route became practically the route of the Canadian Pacific Railway, when it was built.

"The Dewdney trail, which had stopped in 1860 at Princeton, was extended past Keremeos, up Kettle river to Midway, up Boundary creek to Grand Forks, across the Columbia near Trail, and so on by way of Moyie and Cranbrook to Wild Horse Creek. It is well to note that this trail went through places that afterwards played such an important part as mining centres. By the middle of September, 1865, pack trains could travel from Hope to Kootenay entirely in British Columbia territory."

Crow's Nest Trail. As the Dewdney trail provided means of reaching the Kootenay country from the west, so the Crow's Nest trail opened up communication between the Kootenay and the east side of the mountains. The history

of this road is given in a letter from J. S. T. Alexander of Victoria, B.C. dated February 20, 1925, in which he says:—

"It was not until after the establishment of Fort Macleod by the N.W.M. Police in 1874 that the question of making such a trail seems to have been considered. Its purpose was to open up communication with the prairie, which was then beginning to be settled.

"The Kootenay Indians knew of the pass but, before the police came to the prairie, objected to having a trail opened through it as they were afraid that, by means of it, the Blackfeet would find it an easy matter to swoop down on them. Indeed, the name 'Crow's Nest,' literally the lodge or encampment of the Crow Indians, commemorates a massacre of a band of these Indians by the Blackfeet and Bloods at the mouth of the pass close to Turtle Mountain and the present village of Frank.

"The Crow's Nest trail was explored and partly opened in 1879 by Mr. Michael Phillipps, with Isidore, Chief of the Kootenay Indians, as guide. James Morrissey, after whom Morrissey Creek is called, was also of the party. The rivers and streams were all fordable in low water, but the Bull and Elk Rivers had to be bridged to make the trail available at all seasons.

"Mr. Phillipps built the bridge across the Elk River canyon in 1881. This bridge was about 60 feet long and three or four feet wide. It consisted of two squared fir logs with a floor of split timber and a guard rail. A bridge over the Bull River canyon was built the next year and was of similar construction.

"An existing trail, which ran from Wild Horse town down the valley of the Kootenay river to Tobacco plains, was used as far as the crossing of Sand creek. From that place the Crow's Nest or Macleod trail ran east to Elk River canyon, thence up Elk river to Coal creek, up Coal creek to the summit, down Marten creek and the West fork of the South fork of Michel creek, across the South fork of Michel creek and up a small tributary, to the summit of the Rocky mountains. Thence it followed Summit creek to the present site of Crow's Nest station and ran along the north shores of Goose or Island lake and Crow's Nest lake. Then it followed the Middle fork of the Old Man's river, passing to the south of Crow's Nest mountain and under Turtle mountain, the 'Crow's Nest' of the Indians. The trail then left the Middle fork and went over to the South fork of the Old Man's river where it joined the North Kootenay trail and went on by Pincher creek to Macleod.

"This old trail still exists between Crow's Nest Station and Coal creek, though part of it has been widened out into a waggon road, and is still used by hunters and others. The rest of the way it has been practically obliterated by the railway and the waggon road through the pass.

"The period of its greatest use was probably when the N.W.M. Police under Superintendent (later General Sir S. B.) Steele were camped on what is now the townsite of Fort Steele in 1887. This detachment came in via Golden but went back by the Crow's Nest trail. The late Mr. R. L. T. Galbraith told me that when they left he had the contract to pack their impedimenta out over the trail to Macleod."

Canadian Pacific Railway. About the end of the nineteenth century, the Canadian Pacific Railway completed its branch line through the Crow's Nest pass to Kootenay lake. In 1898 the Dominion Government sent out a commission to investigate certain charges made in connection with the construction of this branch railway. The commissioner was the late Roger C. Clute, afterwards a Judge of the High Court of Justice of Ontario. Hearings were held at Lethbridge, Macleod, Pincher Creek, at certain points in the mountains and at Wardner on the upper waters of the Kootenay. At that time rails had been laid to the banks of the Kootenay opposite Wardner.

From Wardner the commission took a river boat downstream to Jennings, the steamer bumping into the bank from time to time to drop or take on passengers and freight. From Jennings they travelled over the Great Northern Railway to Bonners Ferry, where they boarded another steamboat which carried them to Kaslo on Kootenay lake. From there another boat took them to Nelson, where the hearings closed. The railway was not carried beyond Kootenay lake for many years, but recently rails have been laid west to Nelson, connecting there with the old Kettle Valley Railway, and creating a through route from Medicine Hat to Vancouver.

Mining. In various documents relating to the Kootenay Valley one finds, in a fragmentary form, information about the development of mining. Lead was discovered, in what was known as the Blue Bell mine, on Kootenay lake, in the early twenties of the last century. The lead was used by the Hudson's Bay Company for bullets, for their own use in hunting and to sell to the Indians. In the early sixties of the nineteenth century, according to a report by Dr. R. W. Brock, then of the Geological Survey of Canada, 1906, prospectors travelled north across the international boundary, attracted by the rich placers of the Cariboo country, and tested and worked some of the local streams in the boundary country for gold. In 1865 the Dewdney trail was completed from Hope on the Fraser river to the placers of Wild Horse and other East Kootenay creeks. In the eighties some claims were staked in the boundary district; in 1883 at Ainsworth on Kootenay lake, and in 1886, rich ore was discovered on Toad mountain near Nelson. In 1887 the news of this discovery had attracted prospectors, and a trading post was established at Nelson. These discoveries started prospectors along the Dewdney trail, on the lookout for lode ores. The first claim located was the Lily May, on the trail itself, discovered in 1887 and relocated in 1889.

The following is taken from an article in the *Mining and Industrial Record* (Vancouver, November, 1927) by its Editor, E. A. Haggen:—

"It is a far cry back to July, 1897, when the writer made his first trip through East Kootenay. The prospecting boom was at its height. There was then no Crows Nest Pass Railway and the Kootenay Central Railway was not even dreamt of. The means of transportation into that then far-off corner of British Columbia was by the Canadian Pacific Railway to Golden; then by the good ship *Duchess* up the Columbia river to Canal flat on Upper Columbia lake. Tourists who made the trip in those days averred there was nothing like it for comfort of travel and magnificence of scenery. The principal calls were at Carbonate Landing, 17 miles south of Golden and at Windermere. Carbonate Landing was the point of departure for the upper Spillimachene river, where 50 to 60 miners were engaged in the development of the Crown Point, International, Boston and Bennison, Ruth-Vermont Creek, and other properties. The hotel, conducted by Charles Cartwright, now of North Vancouver, was running night and day. Pack trains were continuously on the trails coming and going.

"A fellow passenger on the trip was Hon. R. Randolph Bruce, now (1927) Lieutenant-Governor of British Columbia, then making his first acquaintance with the country which was destined to become his future home, and centre of his later activities in mining and colonization projects. The future Lieutenant-Governor was on his way to Perry Creek, on his first mining engagement—namely, the operation of a test stamp mill for H. C. Hammond of Toronto, one of the founders of the firm of Osler and Hammond. Mr. Hammond had taken a bond on the quartz property there after examination by Dr. Hardman, M.E., of Montreal, who recommended this method of investigation of values.

"These were the real boom days. The rich strikes at the North Star, where horn silver had been found; at the St. Eugene, Sullivan, Stemwinder

and Dibble, had been noised abroad and the country was filled with prospectors between Canal Flat and Fort Steele, then the boom town of East Kootenay, with several saloons running full blast and the bars lined up night and day. From Canal Flat transportation was provided by stage which ploughed axle deep in dust. The North Star, operated by Messrs. Mackenzie and Mann, was the only producing mine. The ore was hauled by waggon in summer and sleigh in winter over a road some fourteen miles in length to the steamboat landing on the Kootenay river near Wasa; then shipped by steamer to Jennings, Montana, where railway transportation to a smelter was available.

"Neil Curran, later manager of the Portland Canal Short Line Railway, and Sir Donald Mann's mining interests at Stewart, was then superintendent at the North Star mine. He was either a 'canny Scot frae Aberdeen' where they say a Jew can't make a living, or he did not go much on mining engineers, for he wanted Dr. Hardman, then one of the leading mining engineers in Canada, to examine and make a report on the North Star mine, and tendered him a specimen of horn silver in payment of his professional services.

"Jim Cronin had recently acquired a half interest in the St. Eugene mine and secured the necessary funds for preliminary development, which he was then carrying on. The other principal properties under development were the Sullivan and Dibble group. Sir George E. Foster was president of the latter company and was on a visit to the mine at the time. He was tendered a banquet at Fort Steele, the writer being among the invited guests. As Sir George was a noted teetotaller, the beverages were confined to tea and cold water, rather a novelty at a banquet in those days.

West Kootenay. "West Kootenay was then the leading mineral producing section of British Columbia, with Slocan and Rossland at the height of the boom, and an output valued at around $6,000,000 a year. Six years ago East Kootenay assumed the role of the richest producing section of British Columbia, with an output to-day of about $34,000,000 or over fifty per cent of the entire mineral production of all mining districts of the province put together. That position will be maintained indefinitely. To-day East Kootenay boasts of the largest silver-lead-zinc mine in the world, with a probable reserve of about 100,000,000 tons of ore; the largest dividend-paying mine in Canada; the largest concentrating mill in the world for silver-lead-zinc ores; the second largest mill in British Columbia for the treatment of similar ores; the largest coal mines in Western Canada; and it is the only producer of metallurgical coke in Western Canada. Great as are these achievements to-day they will probably prove but the foundation of much greater things in store for the future development of the district in view of the fact that the eyes of the world's mining industries are set upon it as one of the greatest storehouses of mineral wealth.

Coal Fields. "No section of British Columbia presents such a variety of mineral resources. The coal fields of the Crows Nest Pass cover an area of 370 square miles, with reserves estimated by the Geological Survey at 56,878,000,000 tons of bituminous coal of high quality. The Flathead valley is a promising oil field. Phosphate rock deposits occur at Fernie, gypsum at Bull river, hot springs and radio-active mineral waters at Fairmont, Sinclair pass and Canoe river, limestone suitable for chemical and fertilizer purposes at many localities, asbestos at Golden, barytes at the Giant mine of Spillimachene, sodalite at Ice river, slate suitable for building construction at Kicking Horse pass, pyrite and pyrrhotite as sources of sulphur for the manufacture of sulphuric acid as produced at Trail. Metallic minerals include gold, silver, copper, lead, zinc, bismuth, arsenic, tungsten, tin, cadmium, antimony, iron and titanium."

In discussing mining development in British Columbia, Dr. Dale L. Pitt, in the article already quoted, says: "Though we cannot follow each rush, it

is essential that we give more than passing attention to the Kootenay discoveries, because these were primarily responsible for the opening up of the eastern part of the province. Spokane, Lewiston and the Boise Basin were quite well populated at the time with many miners attracted by gold in Idaho. When rumours of gold north of the international boundary reached them, and when the gold was actually exhibited, along about 1863, in Spokane, a wild rush was immediately started.

"The natural means ot access to this new country north of the forty-ninth parallel was from Lewiston, Idaho, up through Spokane, along the valley of the Kootenays up to where Cranbrook is now located, and thence on up the Kootenay to Wild Horse creek. By 1864 over one thousand people were congregated here and a real little city started. Practically all supplies came from the United States, with Lewiston, Walla Walla and Umatilla furnishing the bulk, and even distant Salt Lake City sending in cattle.

Wild Horse Creek.—"Wild Horse creek was rich, and the 100 rockers working on the creek in 1864 averaged from two to six ounces of gold daily, and some claims were producing up to $1,000 per day. Its life was short, however, and fickle fortune took away most of its miners up to the Big Bend country. The stories of this country were spread far and wide, and a rush of even bigger proportion than Cariboo was on. Men swarmed in from all sections of British Columbia, and from all the country to the south. Their faith and hopes were unbelievable, in spite of many efforts to make the real facts known. Mining was again opening up and populating the province. The bubble soon burst, however, and the inevitable exodus started. This was a terrible blow to British Columbia and for many years the bad effects of it were felt. There was, however, a great deal of good to come from this immigration. Men finding no gold on the Big Bend, swarmed over other creeks, and commenced scouring the hills in search of gold in place, and out of this came the discovery and development of a far greater wealth—that of lode mining. . . .

Blue Bell Mine. "The first lode mine, the famous old Blue Bell, was discovered in 1882 by prospectors from Bonners Ferry who made their way down the Kootenay and along the east side of Kootenay lake. Litigation, over trying to apply placer-mining law which did not permit more than seventy-two hours' absence from a claim, and finally murder, marked the early history of this property. The complex nature of the ore and the limited development of the art of ore-dressing in that early day were responsible for many years of delay and much disappointment at this property.

Silver King. "Then came the Silver King, on the west arm of Kootenay lake, from which the first forty-ton shipment, made in 1889, gave three hundred ounces of silver to the ton. This brought at least 250 prospectors into the district immediately and Nelson soon sprang up as a result. By 1892 the Columbia and Kootenay Railway, connecting Nelson and Robson, was built, and in 1895 the Nelson and Fort Shippard railway gave this country connections to the entire United States railway system. In Nelson, within a short time, a smelter was built to treat up to 280 tons of copper ore and 100 tons of lead ore per day. Construction of a lead smelter soon followed at Revelstoke, and another at Pilot Bay on Kootenay lake, both to serve this district. With smelters constructed, another milestone in the building of the Province and its industry was passed." . . . .

Slocan. "The completion of the Canadian Pacific Railway's main line in 1885 opened much of the mining country that previously could not be profitably worked, and great volumes of freight were made available for the railway. In the early nineties, the whole eastern part of the province was alive with prospectors. In 1891, Andrew Jardine returned from Ainsworth with

high-grade lead-silver ore from the Blue Ridge Mountains, and the wildest rush of all commenced to the Slocan. Such towns as Three Forks, Kaslo, Slocan, and New Denver soon sprang into existence. The Slocan, Star, Payne, Rambler, Cariboo, and others began adding their wealth to the country and building it up.

Sullivan Mine. "Then came the North Star near Fort Steele, the St. Eugene at Moyie, and the now famous Sullivan near Cranbrook. Each had its day and did its part. Even the Sullivan seemed to pass after a short shipping program. Few realized then what modern developments held in store for the Sullivan. Its complex ores seemed useless, and it appeared that they would never be mined and separated into marketable and profitable metals. But we find the scientific methods of treating these ores and the modern art of smelting them rapidly opening the way to their recovery. The ingenuity and industry of man, coupled with the magic of capital, unlock vast storehouses of wealth. The science of mining and metallurgy builds mighty plants, employs thousands of men, and becomes the backbone of industry."

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III

RECLAMATION DEVELOPMENT

The history of attempts at reclamation in the Kootenay Valley goes back to the early eighties when a British sportsman, W. A. Baillie-Grohman, became interested in the subject and built a canal between the headwaters of the Columbia and the Kootenay at what was afterwards known as Canal Flats. Replying to a statement in the *Victoria Daily Times* by Mr. J. P. Forde of the Dominion Public Works Department in January, 1922, in which he said that the canal " was built in order to turn part of the Kootenay river into the Columbia to enable the North Star steamer to bring ore from the North Star landing at Fort Steele to Golden," the wife of Mr. Baillie-Grohman, who had been out to British Columbia with him, published the following statement:—

Baillie-Grohman and Canal Flats. " The first intention of the builders of the canal was to turn the waters of the Upper Kootenay into the Columbia to help in preventing the overflow of the lands lower down the Kootenay. It was part of the scheme intended to reclaim the whole of the bottom lands of the Kootenay lake district. The other part of the scheme was to widen the narrows at the head of the lake to give free passage to the waters leaving the lake.

" The North Star was a name quite unknown at the time this first Kootenay reclamation scheme was thought of.

" W. A. Baillie-Grohman came as a sportsman into the Kootenay in the early eighties looking for mountain goat and sheep. He was at once struck with the fertile bottom lands of Kootenay lake and wondered if it would not be possible to reclaim them. He foresaw at once the great future value of these lands of rich alluvial deposit. Wandering up and down the Kootenay Lake and river, he saw what he thought would be one means of partly relieving these lands of overflow, to widen the narrows, at or near the place where Nelson now stands I believe. Then he came to the Upper Kootenay and to the flat between that river and the Columbia and felt there was another way to help in reclaiming these lands by turning the Kootenay into the Columbia at this point, or at any rate diverting a considerable volume of water.

" He then brought out a competent English engineer who went fully into the matter on the spot and confirmed Baillie-Grohman's idea as feasible.

" Then he went to Victoria, placed the scheme before the Government and got a large concession of lands in both Kootenay Valleys on the condition that he carried out these two schemes, which were thoroughly approved of by the then Government. A paragraph in the concession also gave him the right to a grant of 350 acres of land for every settler brought in to the country. At that time Kootenay was little known or thought of and British capital and settlers were looked upon as necessary for the good of the Province. With this concession in his pocket, Baillie-Grohman got together a few friends with more money in the bank than he had, scraped together all he could of his own and started work on the canal and on surveying.

Kootenay Valley Company. " He soon found out that more capital would be needed and then formed the Kootenay Valley Company. The canal was begun, Kootenay came to be talked of and the Canadian Pacific Railway heard with horror that the waters of the Kootenay were to be turned into the Colum-

bia, which river was already giving their line considerable trouble at high water. An appeal against the canal was made to the Dominion Government. The Dominion Government then came down on the provincial authorities, asking what right they had to deal with waterways. The canal works were ordered to stop. Already the Kootenay Company had expended much money in preliminary work in surveying, etc., and buying machinery when this belated order came. Baillie-Grohman protested all outlays must be made good, etc., and damages given for withdrawals of concession. So the Chief Commissioner of Lands and Works, Victoria, was on the horns of a dilemma, anger of the powers in Ottawa and the Canadian Pacific Railway and a serious misunderstanding and litigation with English capitalists.

"The outcome was a compromise. The canal should be continued. It could be made a navigable canal with a lock, but the company could go no further than this. My husband pointed out to all that considerable sums would have to be spent on clearing and deepening the channel, where the canal entered the Columbia lake or no navigation would be possible, and he could not undertake that. The Government said they would see to that. So the Kootenay Company carried out their part of the work, the lock and the canal was built. I fancy the clearing by Government has never yet taken place.

"The concession of land in the Upper Kootenay was obtained by the company and they took no further interest, the canal they had no wish to build except as a drainage for their lands. There were no profits coming in to the company at this stage and ever fresh outlays and the directors at home felt nervous. The Chief Commissioner in Victoria was also nervous. Questions were being asked about valuable lands given away and no reclamation being done. However work was begun in Lower Kootenay on the narrows, in the middle of which the company threw up their hands and cried halt and left Baillie-Grohman to pay that season's work on his own. Then they announced they had passed over their rights to the Alberta Exploration Company.

Alberta Exploration Company. "The British Columbia Government only would give its consent to the transfer on condition of the clause *re* settlers being eliminated and further that they should have Government appointed engineers! The Alberta Company were ready to do this but Baillie-Grohman on hearing that it was proposed to thus alter an important clause in the concession and by the said engineers to dam the banks of the river before it entered the lake, saw that endless sums would be wasted and the company might expend hundreds of thousands uselessly, and on these conditions refused to go on working as the company asked him to, as their manager. It was a sad man with a heavy heart that left British Columbia in 1898. He had worked hard at his scheme for some nine years, he loved the country, but could not bear to see others who knew nothing of the country come in and as he said wreck his plans.

"Many years later he was asked to come and advise the company who had, as he prophesied, squandered money uselessly, and told him that they realized he was the only man that had seen what really should have been done and asked if he would go back and look after things for them.

"He felt he could not take up the strenuous life again and had already settled down in his home in a country not unlike British Columbia and devoted himself to literature and other pursuits. During the war he had news of British Columbia from those who came over to help in the great war and was delighted to hear the Kootenay reclamation scheme was again on its feet or being resuscitated. He had hoped to induce his friend Theodore Roosevelt to make a trip to Kootenay with him after the war and to interest him in the reclamation idea, but Roosevelt also 'went West' before peace was signed and Baillie-Grohman followed him to happier hunting grounds last November. It would be a graceful tribute if the flat in future could be named Grohman Flat as it was called in my day. He built the first shanty there, ran the first saw mill, the first store or "Swap House," was the first postmaster and the

first J.P. of Kootenay. He once remarked a mountain was named after him in the country because it was the only one he had *not* been up!

"By his writings he did much to open up the country in these early days and many of the early settlers came in owing to him. It should be noted that it was only under considerable pressure and much against his will that he ever undertook to make a navigable canal with a lock out of what was to have been a drainage ditch. That its usefulness was negatived by the Government neglecting to do their part of clearing the entrance to it from the lake side, and that they utterly neglected the keeping of the lock or canal in repair, which they undertook to, I hear was silting up rapidly a few years after its construction, was no fault of Baillie-Grohman.

"I can vouch for the accuracy of the above account as I was at the flat at the time and interested in the reclamation scheme from the beginning to the end and through being commissioned to write reports home to the directors and to frequently interview the Chief Commissioner of Lands and Works for Baillie-Grohman was able to see what was going on behind the scenes, which to a tenderfoot as I was then, was both wonderful and amazing."

A. S. Farwell. In July, 1883, the Chief Commissioner of Lands and Works of British Columbia instructed Mr. A. S. Farwell to proceed to the Kootenay bottom lands lying between the international boundary and Kootenay lake and to "make such surveys as may be necessary to enable you to report upon the extent and character of the valley on each side of the river, the approximate area of the lands subject to overflow and the average depth of floodwater, and upon the nature and magnitude of the operations necessary to reclaim the submerged lands, together with any information bearing on the subject which you may gather."

Mr. Farwell, accompanied by Mr. J. M. Sproat, arrived at Sand Point, a small railway town on the north shore of Pend d'Oreille lake, where they were met by Mr. Baillie-Grohman with whom arrangements had been made to provide them with transport, etc. They arrived at Bonners Ferry July 20, and after some three months spent in surveying and observing conditions, in the Kootenay basin, Mr. Farwell arrived back at Bonners Ferry on October 28, en route to Victoria.

"The report, following a brief summary of his instructions and movements for the season, is subdivided into the following sections: "Kootenay River," "The Kootenay Bottom Lands," "The Soil," "Climate," "The Foothills," "Kootenay Lake," "The Outlet," "Reclaiming the Kootenay Bottoms," and finally "The Kootenay Mines."

Reclamation. Under the heading "The Kootenay Bottom Lands" Mr. Farwell considers the area of land available for reclamation purposes. He states that a successful reclamation scheme would benefit the lands subject to overflow, to the south of the international boundary line, as much, if not more, than those lying to the north of the line. He roughly estimated the bottom lands in Idaho territory at about 65,000 acres, and the bottom lands subject to overflow between the boundary and Kootenay lake at 45,000 acres, exclusive of rivers, sloughs and permanent lakes.

Mr. Farwell stated that there were four principal flats in the Canadian section as follows:—

No. 1—on the right bank of Kootenay river between the boundary and Goat river, 9,000 acres;

No. 2—on the right bank of the river between Goat river and the lake, 15,000 acres;

No. 3—on the left bank from the boundary northward six miles, 8,000 acres;

No. 4—from the last flat to Rocky Point, 8,000 acres.

In addition to these he referred to the big island at the mouth of the river containing about 5,000 acres. Flat No. 3 above is the area now known as the Reclamation Farm.

Mr. Farwell states that the work of reclaiming these lands will be expensive and difficult. He considers two different methods of doing this—one by enlarging the outlet of Kootenay lake at the narrows (Proctor narrows) and at the first "Rapids" (Grohman rapids), and the other by diverting the flow of the upper Kootenay river into the Upper Columbia lake at what is now known as Canal flats.

With regard to the latter he briefly refers to the probable effect this additional water might have on the low lands of the Upper Columbia river. He states that Major Rodgers, Chief Engineer of the Pacific Division of the Canadian Pacific Railway, informed him that he saw no objection to such a work being undertaken so far as it would interfere with his railway bridges on the Columbia, these structures having to be placed at such a height as to make the question of a little water more or less a matter of no consequence.

Mr. Farwell stated that enlarging the outlet would no doubt materially assist in reducing the height of the water in Kootenay lake but to thoroughly reclaim the bottom lands he was of the opinion that it would be necessary to divert the Upper Kootenay into the Upper Columbia lake.

British Columbia Government. In a public notice issued by the British Columbia Government in November, 1885, it is stated that "in consequence of an agreement entered into between the Government of British Columbia and Mr. Grohman for the reclamation of the Kootenay bottom lands, the lands situated at either side of or near the Columbia river may be henceforth subject to an increased overflow on account of the diversion of the Kootenay river or portion thereof, from its bed or channel into the Columbia lake. All persons intending to preempt or preempting land in the vicinity of the Columbia river will therefore do so upon the above understanding and at their own risk."

Canadian Government. In a report dated August 25, 1886, the Committee of the Privy Council of Canada says:—

"On a Memorandum dated 20th August, 1886, from the Minister of Public Works stating that Mr. Wm. A. Baillie-Grohman, acting on behalf of a company known as the "Kootenay Syndicate, Limited," has represented to the Government that his company has obtained from the Government of British Columbia, in order to promote the early development of Kootenay District, a partially free grant of the swamp and bottom lands lying along the Kootenay river, in the province of British Columbia, on the condition that the lands shall be reclaimed from overflow and colonized within a limited time, and that, to effect this, permission has been given, subject to the consent of the Dominion Government, to construct a canal between the Upper Kootenay river and the Upper Columbia lake (a distance of about one mile), and to lower the level of Kootenay lake by widening and deepening its outlet—and Mr. Grohman now applies for the consent of the Dominion Government.

"The Minister further states that his Chief Engineer reports that the object of the first work is to make a continuous steamboat navigation between Golden City station on the Canadian Pacific Railway, Kootenay City at the head of Columbia lake, and down the Kootenay to the boundary line, or so far as that river is navigable, making a total distance of navigable water of about 200 miles; that objections to the scheme having been raised by residents on the Columbia on the ground that their lands would suffer by turning the Kootenay waters into the Columbia River, Mr. Grohman has so far modified his scheme as to 'offer to guarantee, under pain of forfeiture of permissions given, that his Company shall so construct its works, viz.: the canal and the widening of the

Kootenay's outlet, that the level of the Kootenay shall not at any season of the year or at any point of its course, be lowered below the ordinary low-water level at present in existence, and that with reference to the canal he is prepared to undertake, under a suitable penalty, to keep the gates or lock of the canal permanently closed after the last day of August, except at such intervals when steamers and other craft may pass through the canal.

"That his Chief Engineer further reports that 'Having gone through the papers in this matter and received from Mr. Grohman his explanation of the wishes of his company and the works to be executed by it,' he, the Chief Engineer, 'is of the opinion that the permission asked for might be granted, reserving to the Crown the whole of the rights in the navigation of the rivers mentioned, and not permitting Mr. Grohman or his company to assume any control or the right to interfere with the navigation of the river by other persons or companies, except in so far as the payment of tolls or dues for passing through the canal between the Kootenay and the Columbia, which tolls and dues should be subject to the approval of the Governor in Council.'

"The Minister, upon the report of his Chief Engineer, recommends that permission be given to Mr. Grohman to carry out his modified scheme, subject to the conditions mentioned by the Chief Engineer.

"The Committee advise that permission be given accordingly."

Creston Board of Trade. In a pamphlet published by the Creston, British Columbia, Board of Trade about 1918, the statement is made:—

"In the year 1885, Mr. W. A. Baillie-Grohman secured a concession from the Provincial Government to reclaim these lands. His plan was first to divert the Kootenay river into the Columbia at Canal Flats at which point the two rivers are less than a mile apart. A canal connecting the two waterways, with lock gates, was built, but the plan was never put to the test. At that time the Canadian Pacific Railway were building their main line into the Columbia Valley in accordance with the surveys which did not consider the possibility of the diversion of the run-off from about 1825 square miles of the Upper Kootenay river watershed, into the narrow gorges through which the Columbia flows. The proposed turning would have necessitated changes as great as they would have been costly, and the Provincial Government, on the protest of the railway company, recognizing the mistake which had been made in granting the concession, immediately annulled it. After the abandonment of this method of reclamation, Mr. Baillie-Grohman began excavation work at Grohman creek, but this later was given up, Mr. Grohman realizing, as he says, that he had bitten off more than he could chew. In 1893 an English company, known as the Alberta and British Columbia Exploration Company, Limited, to which Mr. Baillie-Grohman had turned over his concession, misled by incompetent advice, based on insufficient data, abandoned altogether the widening of the outlet, and expended considerable sums in an attempt at partial reclamation by means of dykes. The levees constructed were of insufficient size and cross-section and were crevassed in numerous places by the first flood. For many years interest has been displayed in the drainage of the Kootenay Valley, both in Idaho and British Columbia, and a number of reports have been submitted, but, as a rule, the conclusions have been based on insufficient data."

Kootenay Valleys Company. Following the construction of the canal, it was surrendered to the British Columbia Government, and the Kootenay Syndicate, Limited, transferred all its remaining rights under the indenture of October 30, 1886, to the Kootenay Valleys Company, Limited. The canal it appears was finished in 1889, and thereafter it seems Mr. Baillie-Grohman had difficulty with the English company. He entered into a contract to enlarge the outlet of Kootenay lake at Grohman creek at a cost of $10,000.

Alberta and British Columbia Exploration Company. This company employed Mr. T. S. McVittie, P.L.S., to make a survey of the bottom lands between the international boundary and Kootenay lake which the Kootenay Syndicate, Limited, had planned to reclaim. This was about 1890, and about 45,000 acres were involved. An examination and estimate was also made about the same time by Mr. G. A. Keefer for the same company.

In 1891, following these reports, the Kootenay Valleys Company, Limited, agreed to transfer their interest in the reclamation of the above-mentioned lands to the Alberta and British Columbia Exploration Company, Limited. By an indenture between the province of British Columbia and the last-mentioned company, it was agreed that the company should within six months commence and diligently prosecute the work of reclamation until those portions "subject to overflow shall by reason of the company's reclamation works become fit for agricultural settlement; and thereafter such reclamation works shall be maintained by the said company in good and sufficient repair for ten years." Reclamation was to be effected by diking or otherwise, subject to the approval of the Chief Commissioner of Lands and Works. The province agreed to issue Crown grants to bona fide settlers to the amount of 480 acres. This was not to apply to 1,813 acres set aside as Indian lands.

Boundary Creek. Following the indenture of September 26, 1891, between the province and the Alberta and British Columbia Exploration Company, the latter confined its operations to that portion of the area now known as "The Reclamation Farm". These operations, carried out over a period of years, resulted in a considerable change in the location of the lower portion of the bed of Boundary creek. According to the plans of early surveys Boundary creek originally entered Canada near the foothills on the west side of the Kootenay Valley but immediately returned to the Idaho side of the boundary only to turn northward once more and flow northeasterly through the southern portion of what is known now as the Reclamation Farm. Apparently its course was never surveyed throughout the low lands of the Reclamation Farm but it is shown again to the northwest of the unsurveyed portion. It flowed northward beyond the northern limit of the farm and entered the Kootenay river some seven miles beyond the farm. It would appear that the course of this creek shifted from time to time as several different dry watercourses and apparent creek beds have been reported at different points in the farm.

Without at this point attempting to follow further the steps that led up to the applications to the Commission on behalf of the Creston Reclamation Company and the Trustee in Bankruptcy of the Kootenay Valley Power and Development Company, Limited, it will be convenient to consider several later investigations in connection with the reclamation of Kootenay flats.

Otto Weile. In 1905 private interests represented by C. C. Reeder of Spokane, Washington, engaged Otto Weile, Consulting Engineer, Spokane, to investigate the feasibility of reclaiming Kootenay flats. He reported that the scheme was practicable, provided the outlet of the lake was enlarged, control works provided there and a dike built at the head of Kootenay lake to prevent the flooding of the flats by the backing up of flood waters of the lake.

It appears from Mr. Weile's report that in his view the proper and adequate reclamation of Kootenay flats required two major operations, the construction of dikes on the flats to keep the water off the land and the enlargement of the lake outlets to protect against high water. He was also of the opinion that a control dam in the outlet "would retard the flow of water as it receded in the fall and winter months and have a tendency to make the lake a reservoir which

would, of course, be a benefit to the power plant, and would in no way injure the interests of navigation, the people at Nelson, or the owners of Kootenay flats."

H. F. Meurling. In 1912 the Government of British Columbia engaged Mr. H. F. Meurling, Civil Engineer, to investigate the feasibility and cost of reclaiming Kootenay flats. In submitting his report in 1913 to the Minister of Lands of British Columbia, Mr. Meurling stated that complete reclamation of the flats depended upon controlling the level of Kootenay lake by the building of control works at the natural control in the outlet of the lake, that is to say the rapids below Grohman creek, by deepening and enlarging the channel above and below such points of control, and by improving the drainage channels in the flats.

Mr. Meurling said in his report, "The main obstruction (in the outlet of Kootenay lake) must therefore be below Nelson, British Columbia, and not on the West Arm, as former investigations seem to indicate, and this obstruction I found to be the natural dam forming the rapids below Grohman creek. . . . This dam consists of boulders massed across the river, and forming a crest over which the water flows, and three narrow channels forming the rapids at low water. This dam prevents the lowering of the surface of the lake further than to the level of its crest, and is therefore to be considered the key to the whole proposition.

Mr. Meurling outlined a plan by which he believed it would not only be possible to dispose of the flood water and always balance inflow and outflow but also to control perfectly the level of the lake at any time of the year. This plan called for a dam at some point below Grohman Rapids, which would take the place of the present natural obstruction and be so fitted with locks and gates that by opening or shutting these it would be possible to pass a maximum or minimum of water.

In regard to the effect of these gates he says: "In the winter the lower gates would be kept shut and the upper open only long enough to allow of passage through of the more or less constant low water flow, but as soon as the flood water from the mountains in the spring begin to raise the level of the lake the lower gates would be opened to allow passage through of an amount equal to the increased inflow, whereby the inflow and outflow would always be kept balancing.

"The level of the lake would thus be kept at a constant stage, that is the present low-water stage, and all flooding of the flats would be prevented.

"As soon as the extreme flood has passed the gates would gradually be shut down again and in the fall and winter only the ordinary flow kept running.

"This general outline is the plan by which I proposed to solve the problem of reclamation and disposal of the flood water."

Mr. Meurling expresses the view that "this natural dam controls the lake level at low as well as at high water and through it or a similar one must the lake be controlled if success with reclamation is to be expected."

Channel Improvements. In regard to channel improvement work in the flats, Mr Meurling says: "The satisfactory disposal of the flood water is, however, not wholly solved by the construction of the controlling dam on the West arm as certain parts of the flats are subject to flooding from breaks in the channel and river banks as well as drainage off the bounding mountain sides.

"It is seen from the contour plan of the flats that flood water from the creeks and rivers running down the mountain on both sides of the flats has cut distinctive channels on both sides of the Kootenay river which channels serve as drainage canals for the floods from Goat river, Duck creek and smaller creeks on the east side and Boundary creek, Corn creek, and Summit creek on the west side.

"The floods from these creeks are earlier than the flood from Kootenay river, a fact which can be taken advantage of by the cleaning out and straightening out of these channels so that this flood water is carried down to the lake and disposed of before the flood from Kootenay river has begun in earnest.

"It is therefore necessary to clean out and dredge part of Goat river, Goat river slough, Duck creek channel through Duck lake and under the C.P.R. bridge, on the east side and Boundary creek channel, Nicks channel, Corn creek, and Summit creek on the west side, together with some cleaning out of the main river and its east branch from logs, etc., along the banks to protect the same and prevent damage as much as possible from scouring."

Jones and Ramser. In 1915 and 1916 the United States Department of Agriculture made an exhaustive investigation of the feasibility of reclaiming Kootenay flats in Idaho. Messrs. L. A. Jones and C. E. Ramser, drainage engineers of that department, carried out the field work and submitted their report in May, 1917, to Mr. S. H. McCrory, Chief of Drainage Investigations.

The Drainage Problem. In this report Messrs Jones and Ramser say: "The existing flood conditions in the Kootenai valley are caused by the high water stages in Kootenai lake, together with the inadequate capacity of the present river channel. To obtain relief the amount of flood water must be reduced sufficiently for the channel to carry the flow, or an adequate channel must be provided to carry the excess water, either below or above the ground.

Run-off. "With reference to the 1916 flood, the maximum stage of the Kootenai river occurred on June 22nd; on that date a reading of 32·85 was obtained on the Bonners Ferry highway bridge gauge. The discharge of the river, as measured at the maximum stage, was about 126,000 cubic feet per second. This means that for any system of complete protection of the Kootenai valley lands against over-flow like that of 1916, it would be necessary to provide means for the removal of the above-named discharge, plus that which enters the river between Bonners Ferry and the international boundary.

The 1916 Flood. "Owing to the fact that the river banks are several feet higher than the bottoms, it would be necessary to place the levees on this high land, immediately adjoining the river. Where a river is so confined between levees its flood levels are raised, and in this case the level of Kootenai lake also would be raised if the capacity of the West arm were not increased. It was estimated that for the 1916 flood the amount of storage water over the river bottoms would have raised the level of the lake about two (2) feet if the flood had been confined to the river channel between levees."

Reducing Stages of Kootenay Lake. "Investigations were made to determine the effect upon the flow in the Kootenai river to be obtained by lowering the level of Kootenai lake, this to be accomplished by enlarging the capacity of the West arm, the outlet of the lake. Except at four points the West arm varies from one-quarter of a mile to over one mile in width. Contractions at these four points greatly reduce the capacity of the channel. To increase the capacity the contracted sections would need to be enlarged greatly.

"It was found that if the level of the water at Porthill were lowered five feet below the maximum stage for the 1916 flood, the capacity of the river would be considerably increased for a short distance but not sufficiently to enable the present river channel to carry all of the flood water." . . . "It can be seen from these curves that the effect upon the capacity of the river, to be obtained by lowering the lake, decreases very appreciably with the distance up the river, and that near Bonners Ferry the effect is to lower the water surface

about 1½ feet below the stage as computed for the leveed channel where the lake is not lowered. In order to protect against such floods as that of 1916, it is seen that even if the water level were lowered five feet at Porthill, levees still would be required along the greater portion of the river banks.

Diversion of the Upper Kootenay River at Canal Flats. " If in addition to this work (proposed Canal Flats diversion referred to hereinafter) the West arm of the lake were enlarged, the river channel would then be capable of handling the reduced flow of all the floods except those of 1894, 1903 and 1916, or all but three floods in the past twenty-three years. Upon this basis one flood in about eight years could be expected. Finally if in conjunction with the diversion of the Upper Kootenay river and the enlargement of the West arm, levees were constructed along the river, complete protection could be obtained against all such floods as have occurred during the past twenty-three years."

Plans Considered. Eight possible plans were investigated by Messrs Jones and Ramser; four for practically complete, and four for partial reclamation of Kootenay Valley lands; and four separate and distinct methods of controlling or reducing the floods of the Kootenay river formed the basis of these investigations. Various combination of these four methods make up the eight plans. The four methods are:—

(*a*) System of levees;
(*b*) Enlarging West arm of Kootenay lake;
(*c*) Diversion of Upper Kootenay river;
(*d*) Closing openings in the river banks.

Plans involving (*b*) were not recommended at the time because of the high cost and the probable delay which would be involved in obtaining the co-operation of the Canadian Government.

Conclusions. The following are the conclusions of Messrs. Jones and Ramser:—"Plans Numbers 1, 2, 3 and 4 involve the use of levees. Owing to existing conditions the levees would have to be built directly on the banks of the river. The effect would be to raise the flood level and greatly increase the velocity of the current. On account of the many bends in the river and the position of the levees on the banks it is questionable whether the levees would withstand the effect of erosion and the tendency to undermine and cave at the banks. Also the cost of proper maintenance for such a levee system would certainly be very high.

"In plans Numbers 2, 4, 5 and 6 is included the enlarging of the West arm of Kootenai lake to effect a lowering of the level of the lake and thereby increase the hydraulic gradient and the capacity of the Kootenai river above. This work alone would not give complete reclamation to the Kootenai Valley land. Only that part of the valley in Canada and a small portion of that in the United States would be protected against overflows without the use of levees, provided the maximum stage during the flood of 1916 at Porthill could be lowered 5 feet. Owing to the lack of cross-sectional data respecting the river between Porthill and the lake, the amount that the water could be lowered at Porthill could not be determined closely. The lack of similar data for the West arm of Kootenai lake makes it impossible to prepare a close estimate of the necessary amount of enlargement or of the cost of the work. Should it be decided to adopt any one of the plans in which this work is included, it is advised that the missing data be obtained and a more extensive study made.

The engineers recommended the adoption of Plan No. 7 involving: (*a*) closing of openings in the river banks and construction of levees along the larger creeks; (*b*) construction of interior drainage ditches with sluice gates and pumping plants; and (*c*) diversion of Kootenay river into the Columbia at

Canal flats. In case of delay on the part of the Canadian Government in making the diversion at Canal flats the engineers recommended the carrying out of the other features of the recommended plan. This constituted Plan No. 8.

"It is possible that satisfactory interior drainage could be secured in most of the districts without the use of pumping plants, in view of the light rainfall and the conditions favourable to high absorption by the soil. However, there may be considerable seepage from the river during high stages which would require the use of pumps. It is believed advisable to experiment for one year without the pumping plants, and then if it is found necessary to install them, it can be done."

W. G. Sloan. In 1921 the Reclamation Commission of the State of Idaho arranged for a study of the feasibility and cost of reclaiming Kootenay flats, to be carried out by Mr. W. G. Sloan. Mr. Sloan assembled all the available data from previous investigations and basing his studies thereon reached certain conclusions with respect to the feasibility of the reclamation proposals which he embodied in a report submitted to Mr. W. G. Swendsen, Commissioner of Reclamation for the State of Idaho.

All of Mr. Sloan's studies and calculations had as a basis the control, within certain limits, of the level of Kootenay lake which was to be effected by enlarging the lake's outlet and the construction of control works therein. In this connection Mr. Sloan states:—

"The real outlet of Kootenay lake is between Nelson and Granite where a large fall is available at both high and low water stages. Whether all of this fall is concentrated at Grohman Rapids or is scattered throughout the reach of three miles is not known since topography is only available for short reaches at Grohman and Granite. At low water several rapids can be seen below Grohman but these are probably submerged at high water. It is certain that there is at least 5 feet of fall concentrated at the Grohman rapids.

"Any plan which calls for holding the level of Kootenay lake at a fixed elevation must necessarily involve the removal of the rapids at Grohman in order to get the required capacity in the West arm. Before this can be done, however, it is essential that some means be found for controlling the lake level so that its present low water elevation can be maintained, for if the rapids were removed without this control the level of the lake would be so low that navigation would be seriously interfered with.

"The only practical location for such a control is at Granite. Here a rough rock ledge extends across the entire channel and creates a fall of 17 feet. The topography taken at the dam site does not cover all of the territory which should be examined before a dam location is determined, but it is apparent that no trouble will be found in choosing an excellent dam site with good foundations. The required structure would only be a series of gates so arranged that the maximum flood can be passed without raising the flood height above the desired lake level and will permit of holding the lake at present low water level.

"My present impression is that these gates should probably be of the rolling dam type such as were used by the Reclamation Service on the Grand river diversion dam near Grand Junction, Colorado. This type permits a minimum number of piers and has the advantage of extreme ease of operation. The details of the whole design, however, must be left for future consideration. In order to pass the maximum floods it will be necessary to remove about 90,000 cubic yards of rock from the channel below the structure."

Mr. Sloan reported upon schemes involving enlargement of the outlet of Kootenay lake to a capacity of 150,000 second feet, (*a*) with the lake elevation lowered about 10 feet and (*b*) with the lake at average low water elevation. He also reported upon a scheme involving enlargement of the lake outlet to a capacity of 200,000 second feet at average low water elevation. Throughout, Mr. Sloan's aim appeared to be to provide a suitable scheme without the aid of main channel levees.

Mr. Sloan made the following statement: " The conclusion has been reached, however, that if the lake level is held to elevation 1,747·8, the river channel can take care of floods as high as 110,000 second feet without levees, as far up as Bonners Ferry if all bank openings are closed and the side creeks are leveed to the river. Protection will thus be afforded against practically all of such floods as have occurred in the last twenty-six years except two.

" If it is not feasible to afford complete reclamation for the overflowed lands above Kootenay lake it will not be necessary to enlarge the West arm to a capacity of 200,000 second feet. If 100,000 second feet is the maximum flood considered above the lake, then a capacity of 150,000 second feet will be sufficient for the West arm. A channel 400 feet wide, on the bottom, 35 feet deep on a slope of ·00035, side slopes of $1\frac{1}{2}$ to 1 with a bottom grade the same as that calculated for no rise in the lake level at a discharge of 200,000 second feet will fulfil all the conditions. The quantities involved would be as follows:—

	Cu. Yards
" At Grohman Rapids..	800,000
Proctor Narrows..	1,200,000
Kootenay Landing..	500,000
Total..	2,500,000

Recommended Plan. " The apparent solution of the whole problem then appears to be a plan with the following features:—

" (1) Regulating gates at Granite to maintain present low water.

(2) Enlargement of the West arm to carry 150,000 second feet at average low water of Kootenay lake.

(3) Closure of all bank openings in the main river channel.

(4) Construction of a limited number of interior drainage ditches.

(5) Levees to carry side tributaries to the river channel.

(6) Sluiceways to pass interior drainage into the river."

Cost. The following estimate of cost was submitted by Mr. Sloan to cover the enlargement of the outlet, control works and land drainage works, etc.:—

" The estimate which follows is of course subject to revision as soon as additional information becomes available and is intended only as a guide in determining the feasibility of the plan.

Enlarging the West arm, 2,000,000 cubic yards at 30 cents..	$ 600,000
Deepening channel at Kootenay Landing, 500,000 cubic yards at 30 cents..	150,000
Improvements at Granite..	400,000
	$1,150,000

Conclusions. Mr. Sloan's general conclusions were as follows: " The enlargement of the West arm to pass the highest floods of record so that Kootenay lake will not rise beyond a point 9·6 feet lower than the maximum height of 1916 will not enable the river channel above the lake to pass the highest floods without requiring high levees even before Porthill is reached.

" The enlargement of the West arm so as to pass the maximum floods without raising Kootenay lake above average low water might afford complete protection for lands on the Canadian side, but will not prevent the need for high levees on the Idaho side.

"The feasible plan seems to be to enlarge the West arm to a capacity of 150,000 second feet, thus preventing a rise in the lake for all floods which do not exceed 110,000 second feet above the lake. For such floods the river channel will then have sufficient capacity without the use of levees as far up as Bonners Ferry.

"Together with the interior drainage ditches, creek levees, bank closures, and sluiceways, this improvement will protect all the lands against overflow from all such floods as have occurred in the last twenty-six years except those of 1894 and 1916."

Swendsen and Cleveland. In 1922 the State of Idaho and the Province of British Columbia carried out a joint investigation looking to the reclamation of Kootenay flats. Mr. W. G. Swendsen, Commissioner of Reclamation, Idaho, and Mr. E. A. Cleveland, Comptroller of Water Rights, British Columbia, were entrusted with the work for their respective Governments and in 1923 they submitted practically duplicate reports.

The reports point out that the flooding of Kootenay flats very largely results from back-water effects of Kootenay lake, due to the insufficient capacity of the lake's outlet. In this connection the following statements appear in the reports:—

"This arm (Kootenay lake outlet) is constricted in several places and during the period of high runoff, water can not escape from the lake as rapidly as it runs in, thus a raise in the elevation of the lake water surface results to the extent of about 30 feet during extreme high water periods. This results in a flattening of the river grade from its point of discharge into the lake at Kootenai Landing up stream to a point near Bonners Ferry with the result that the channel capacity is materially decreased, thus causing an overflow of the entire river valley.

"The problem of reclamation, therefore, becomes one of increasing river channel capacity, so as to prevent inundation and possible water-logging of the areas to be reclaimed.

"A general study of conditions indicates that this capacity may be increased by one or a combination of the following methods:—

"(A) Lowering the lake level by increasing the capacity of the West arm at the restricted sections and by increasing the capacity of the lake outlet at Granite, a point about four miles below Nelson, thus retaining in part at least, the same river grade during flood stages, as exists during the low water period.

"(B) Increasing the cross section or size of the river channel from Bonners Ferry to the lake by diking or raising river banks.

"(C) Increasing the size or cross section of the river channel by dredging.

"In addition to the foregoing, a plan must be devised to take care of the flood discharge from tributary streams entering the valley between Bonners Ferry and Porthill....

Channel Improvements. "The problem of lowering the present high water level of Kootenai lake, as has hereinbefore been indicated, involves an increase in the capacity or cross-sectional area of the West arm at several points where the channel is constricted.

"At Grohman rapids, two miles below Nelson, the river channel has been narrowed by a deposit of material eroded from Grohman creek, by an island which has the appearance of being a fragment of the delta pushed out, perhaps by glacial action, and by sharp projecting points of solid rock on the south shore. To obtain the required capacity at this point, it will be necessary to

remove a considerable portion of this delta deposit. A superficial examination indicates that materials which might be encountered will be very heavy, consisting of gravel and sand intermixed with coarse gravel and boulders, the latter containing as much as one cubic yard. This material may be disposed of by transporting it on barges to the deeper portions of the channel or lake arm above. If the work is undertaken during low water period, a portion of the material may be removed in the dry, although a considerable amount thereof will of necessity be wet excavation.

"There are also constrictions in the channel of the West arm at Nine Mile point, Thirteen Mile point, Harrop and Proctor narrows, all of which will require considerable dredging in order to provide the necessary cross-section. The materials at these points, judging from surface indications, consist of alluvial deposits of soil, sand and gravel, intermixed with boulders of moderate size. These materials are so situated that it is not considered practicable to make any of the excavations in the dry. The excavated material can perhaps best be disposed of by transporting it to portions of the West arm on barges....

"In addition to providing a greater capacity than now exists in the West arm, it will be necessary to erect control works at Granite, the present outlet of the lake.

"At this point, solid granite is exposed on both sides of the stream, and across the channel to the lower water level, and every indication points to the probability that the low water channel at this point is also in solid granite.

Control Works. "In order to accommodate navigation needs and avoid serious interference with commerce, including docks, etc., the present minimum lake level must be retained, thus the necessity for controlling works designed and constructed so as to permit regulation of flow. If a favourable site for such control works existed further upstream and near the true outlet to the lake, control works having less height might be employed. This, however, does not seem probable and it is quite certain that the extra height of the dam necessary by reason of the selection of the site at Granite will be more than offset by the favourable foundation conditions which apparently exist.

"In order to secure adequate provision for passing a great volume of water during the flood stage, it seems imperative that a long crest type dam be adopted. Even after utilizing all of the crest length that topographical conditions afford for this structure it will be necessary to provide a large gate capacity or opening so planned and constructed that the gates may be closed during stages of low-stream flow, thus holding the lake level up in the interest of navigation.....

"If a general reclamation of the Kootenai flats is to be undertaken, it cannot be accomplished successfully without, first—a lowering of the lake level; second—a dredging of the Kootenai river, and third—diking low places and filling breaks in the present river banks, and an improvement and diking of tributary channels, all as outlined in the foregoing, and even when this is accomplished, inundation will not be prevented under such conditions as prevailed in 1894 and 1916.

The following details of the required improvements to the outlet of Kootenay lake are contained in the reports:—

"Dam and excavation at Granite, river and control	$400,000
Excavation at Grohman rapids (830,000 cubic yards)	581,000
Excavation at Proctor narrows (1,010,000 cubic yards)	404,000
Total	$1,385,000."

United States Corps of Engineers. In 1931, under the provisions of an Act of Congress approved February 12, 1929, the United States Corps of Army Engineers submitted to the Speaker of the House of Representatives a report upon a preliminary examination of the Kootenay river, Idaho, with a view to the control of its floods.

The material was submitted to the 72nd Congress, 1st Session, as Document 157. It mainly consisted of:—

A report dated January 15, 1931, by Major John S. Butler of the United States Corps of Engineers, and District Engineer at Seattle.

A review of this report by Colonel Herbert Deakyne, of the United States Corps of Engineers, Senior Member of the Board of Enginers for Rivers and Harbours, dated September 29, 1931, concurring in and supporting the recommendations of the District Engineer

A covering report dated December 9, 1931, by Major-General Lytle Brown, Chief of Engineers, concurring in the recommendations of the Board of Engineers for Rivers and Harbours and transmitting the same to the Secretary of War for the United States. The study presents a very complete review of the conditions obtaining on the Kootenay river, particularly with respect to its high flow characteristics and the particular relationships of these to the drainage districts on the Kootenay flats.

Report of District Engineer. The following extracts from Major Butler's report are relevant:—

"87. Storage in Kootenai lake as proposed might very largely increase the duty of pumping from Districts 1, 6 and 7 during October, November and December if it were found necessary to maintain a low-water table in the reclaimed land during these months. The other districts would still have sufficient fall during these months to provide drainage. District No. 1 is in the most serious condition, as it includes the lowest land within the valley. Prior to its reclamation a permanent lake covered between 1,500 and 2,000 acres of the district. The greater part of the area is so low that difficulty is found in providing proper drainage, although every inch of available fall is used.

"88. Seepage is an additional factor for consideration. Should the water in the river be maintained at a higher elevation than at present, seepage would be increased and require additional pumping. During floods seepage has caused rather serious trouble. The greater part of the seepage was underneath the dikes. It was estimated that the maximum inflow in the various districts, due to this cause, was from 10 to 24 second-feet depending on the head and length of dike. Duration of floods also affects the seepage rate.

"89. With reference to the adequacy of the existing dikes, Mr. Jessup estimated that the dikes of districts Nos. 1, 2, 3, 5 and 8 would have failed in a flood like that which occurred in 1916, and that the dikes in districts Nos. 4 and 9 would have been overtopped. The dike in district No. 6 failed during the flood of 1927. Mr. Jessup further estimated that a flood having a stage equal to that computed by Jones and Ramser for a flood like 1916, with the entire valley in Idaho reclaimed, would have overtopped the dikes of all districts except No. 8 and possibly No. 1. At the time of that flood, a lowering of the lake as proposed by the West Kootenay Power and Light Company would have been of considerable benefit, and would have averted some damage. The 1916 flood discharge was about 145,000 second-feet at Nelson. Referring to the water-surface profiles, sheet 2, chart 2, it is seen that the lake could have been held more than 1 foot lower, with the company's proposed improvements, than under natural conditions. When the entire valley between Bonners Ferry and Kootenai lake has been reclaimed, it will be necessary to lower the lake surface several feet to prevent flooding of the valley lands in Idaho during a flood equal to that of 1916.

"90. The report of L. T. Jessup indicates that it would be impracticable to construct levees in Idaho of the necessary height to provide absolute protection from floods equal to those of 1894 and 1916. To provide complete protection in the upper end of the valley, the lake level should probably be lowered at least six feet below that of the 1916 flood, although a lowering of the lake from 1 to 3 feet might be sufficient to prevent excessive damage in the section between Copeland and Port Hill during floods which have occurred since 1916.

"91. Holding the water level in Kootenai lake at an elevation of approximately 6 feet above the zero of Nelson, British Columbia, gage during a greater portion of the low-water period, from about October to March, would retard the natural drainage of the lowlands in some of the districts during that period and additional pumping might be required. Drainage, however, would not be materially affected during the cropping season, which ends about September 30.

"92. None of the valley land in Idaho is below the elevation of the proposed storage line, but a number of the existing gravity-drainage outlets would be partially submerged during the storage period.

"93. It is believed that some relief from floods in Kootenai valley, Idaho, can be obtained by lowering Kootenai lake. Diverting Kootenai river above Canal flats into the Columbia river during flood periods would also aid in reducing flood damage. Lowering the lake level 2 or 3 feet, combined with the diversion, may provide sufficient protection, whereas without diversion a lowering of at least 6 feet at Kootenai lake may be necessary. It may not be practicable to do work in Idaho which will greatly improve conditions, since it is considered infeasible to materially increase the height of the existing levees and to construct a flood way or deepen the river channel.

"94. In connection with the dam and compensatory works proposed by the West Kootenay Power and Light Company, it seems that the use of storage as proposed is desirable for the highest utilization of the potential power in the Kootenai and in the Columbia, and the compensatory works will be of benefit during flood stages to all overflow lands in the valley above the lake, in Canada as well as in the United States, in that it will increase the discharge capacity of the river.

"95. The reclaimed areas in Idaho are at present probably subject to the possibilities of greater damage from floods during the summer season than from improper drainage of the subsoil due to raising the water table during the fall and winter months.

"96. Floods in Kootenai valley, Idaho, are liable to reach destructive magnitude with greater frequency as new areas are reclaimed, thus confining the flow between levees in a narrower channel. Floods occur during May and June, and if a levee were overtopped by flood water, practically the entire crop behind the levee would be destroyed and the production for that year lost."...

Conclusions. "103. It appears that about two-thirds of the Kootenai river, including both its source and outlet, are in Canada and that any works of flood control would be at Canal flats or Kootenai lake, both in Canada. The problem of flood control is therefore of international interest. Diversion of water at Canal flats will affect interests on the Columbia. Storage of water, during low-water periods in Kootenai lake may be detrimental to the proper drainage of lands in the Kootenai valley within the United States, whereas increasing the discharge capacity of the lake outlet will reduce flood heights in the valley below Bonners Ferry.

"104. It may be possible to construct dikes of sufficient height to exclude the floods from the valley lands, but it is doubtful if these would withstand a maximum flood or even a lesser flood of long duration. The cost of such dikes would also be very great. Reducing flood heights on Kootenai lake by increas-

ing the outlet capacity, combined with a proper and well co-ordinated system of dikes appears to offer the best solution of the flood-control problem. This combination can be effected only by joint action between Canada and the United States and this joint action can best be secured through the International Joint Commission. It is my opinion that the construction of the individual or combination works just mentioned would not materially affect the navigability of the stream in the United States and hence the War Department will not be concerned, on the score of navigation, in those improvements.

Recommendations. " 105. In view of the foregoing, it is my opinion that the matter is one that should properly be considered by the International Joint Commission and not by any agency acting only for the United States. I, therefore, recommend that no further study or report be made by this department unless it is called upon by the International Joint Commission or further directed by higher authority to furnish engineering data or to prepare flood-control plans for the use of the International Joint Commission as a basis on which to reach a satisfactory agreement with Canada."

It will be noted that Major Butler finds that the drainage districts in the past have been very seriously damaged by the over-topping of existing dikes and that "to provide complete protection in the upper end of the valley, the lake level should probably be lowered at least six feet below that of the 1916 flood, although a lowering of the lake from one to three feet might be sufficient to prevent damage in the section between Copeland and Port Hill during floods which have occurred since 1916."

He furthermore points out that "it may not be practicable to do work in Idaho which will greatly improve conditions" (i.e. conditions conducive to over-topping the dikes), since it is considered infeasible to materially increase the height of existing levees and to construct a flood way or deepen the river channel."

He points out that "lowering the Kootenay lake level two or three feet combined with the diversion" (i.e. of water from the Kootenay river above Canal flats into the Columbia river during flood periods) "may provide sufficient protection, whereas without such diversion a lowering of at least six feet at Kootenay lake may be necessary."

He furthermore points out that while "holding the water level in Kootenay lake at an elevation of approximately six feet above the zero of the Nelson, B.C. gauge during a greater portion of the low water period, from about October to March, would retard the natural drainage of the low lands in some of the districts during that period and additional pumping might be required," that "drainage, however, would not be materially affected during the cropping season, which ends about September 30th."

He states that "the reclaimed areas in Idaho are at present probably subject to the possibilities of greater damage from floods during the summer season than from improper drainage of the sub-soil due to the raising of the water table during the fall and winter months."

He points out that "in connection with the dam and compensatory works proposed by the West Kootenay Power and Light Company, it seems that the use of the storage as proposed is desirable for the highest utilization of the potential power in the Kootenay and in the Columbia" (i.e. in the 1,300 foot drop which can be commercially developed on the Columbia river in the United States—there being no developable drop on the Columbia in Canada from the point at which the Kootenay river enters the Columbia to the international boundary); "and the compensatory works will be of benefit during flood stages to all overflow lands in the valley above the lake, in Canada as well as in the United States, in that it will increase the discharge capacity of the river."

Major Butler finally concludes that "reducing the flood heights on Kootenay lake by increasing the outlet capacity, combined with a proper and well co-ordinated system of dykes appears to offer the best solution of the flood control problem. This combination can be effected only by joint action between Canada and the United States and this joint action can best be secured through the International Joint Commission."

It is furthermore his view that the matter " is one which should properly be considered by the International Joint Commission and not by any agency acting only for the United States " (or, he would imply, for Canada).

Report of Board for Rivers and Harbors. The following extracts from the covering report of Colonel Herbert Deakyne of the Board of Engineers for Rivers and Harbors are relevant:—

" 7. The levees afford protection to about 22,000 acres for all except the largest floods. It is the general opinion that an increase in levee heights is impracticable and that additional protection can be obtained only by the lowering of the flood plane. The lowering of the flood plane would be accomplished by the enlargement of the outlet of Kootenai Lake and also to a limited extent by diversion of the upper Kootenai River into the Columbia river. Both of these improvements would be in Canada and authorization for the works must come from the International Joint Commission. The reclamation of the remainder of the flood plain, consisting of about 9,000 acres, and the raising of existing levees to protect against the greatest floods, are roughly estimated to cost $1,450,000."

"9. The district engineer reports that none of the improvements for further flood protection will affect the navigability of the stream. Further protection through the reduction of flood heights on Kootenai lake by increasing the outlet capacity, and the problems relative to proposed improvements below the international border and in British Columbia can be effected only by joint action between Canada and the United States through the International Joint Commission. These works would not affect navigation, and he is of the opinion that the War Department will not be concerned in them and that they are being properly considered by the International Joint Commission. The extension of the levee system to the 9,000 acres of unleveed land or the raising of the levees to give greater protection against maximum floods would be purely local matters not affecting any national interest. The cost of a survey is estimated at $7,000. The district engineer recommends that no further study or report be made by this department unless it is called upon by the International Joint Commission or further directed by higher authority to furnsh engineering data, or to prepare flood-control plans for the use of the International Joint Commission as a basis on which to reach a satisfactory agreement with Canada. The division engineer concurs.

" 10. The Board of Engineers for Rivers and Harbors concurs in the recommendations of the district and division engineers. The protection of part of the lowlands in the Kootenai Valley in Idaho has been secured by local drainage districts through the construction of levees and the installation of drainage works. The levees are of sufficient height to exclude all except the major floods. Improvements of this type are local in character, and enlargements, or extensions to include greater areas, will be primarily of local benefit. They will not affect any present or prospective improvement for navigation, and Federal participation therein is not justified. The protection of the existing improvements, and the land they inclose, from damage by the proposed developments on the Kootenai river in Canada and the attaining of flood control by enlargement of the outlet of the lake are matters coming under the Treaty of 1909 between the United States and Canada, which requires that authorization for the construction

of works affecting the level of international waters shall be obtained from the International Joint Commission. The latter is making extensive field and office investigations to establish a basis for its future action on the applications for these improvements. In view of the foregoing, the Board is of the opinion that a survey by the War Department is not necessary."

It will be noted from the foregoing that the report of the Board of Engineers for Rivers and Harbours concurs with and supports the recommendations of the District and Division Engineers.

Report of Chief of Engineers. The following extracts from the report of Major General Lytle Brown, Chief of Engineers, are relevant:—

"7. The district engineer reports that it is not practicable to construct reservoirs for the control of floods within the limits of the United States; nor indeed is reservoir control practicable even in the headwaters of the stream in Canada. While a diversion of the flood waters from the upper reaches of the stream in Canada across the low divide into the Columbia river appears possible, the damage to the lowlands on the Columbia from such diversion might outweigh the benefits. Experience with the existing levees indicates that higher levees than those now in use would be unsafe. The straightening of the river channel in the valley above Kootenai lake would not provide sufficient flood relief, would entail expensive reconstruction of levees, and might produce dangerous velocities. The enlargement of the river channel in this section is also believed impracticable. He reports that the best apparent solution for the flood-control problem is to reduce the flood heights in Kootenai lake by increasing the outlet capacity, combined with a proper and well co-ordinated system of levees. Such work can be carried out only by joint action between the United States and Canada under existing treaty provisions. The necessary investigations on which to base a conclusion are now being made. He states that the estimated cost of field and office work necessary to prepare plans for flood control works in the United States, utilizing the data already secured by the Geological Survey, would be $7,000. He recommends that no survey be authorized. The division engineer concurs.

"8. The report of the district engineer has been referred, as required by law, to the Board of Engineers for Rivers and Harbours and attention is invited to its report herewith agreeing with the district and division engineers.

"9. After due consideration of the above-mentioned reports, I concur in the recommendations of the Board of Engineers for Rivers and Harbours. Further levee construction below Bonners Ferry would be primarily of local benefit. Such work will not affect any present prospective navigation improvement and Federal participation therein is not justified. The protection of the existing improvements and the land they enclose from damage by proposed developments in Canada and the attaining of a greater degree of flood control by enlargement of the outlet of Kootenai lake are matters coming under the Treaty of 1909, which requires that authorization for the construction of works affecting the level of international waters shall be obtained from the International Joint Commission. This Commission is now making extensive field and office investigations to establish a basis for its future action on the applications for these projects. Under these conditions a survey by the War Department would be an unnecessary duplication of work. I therefore report that no further survey of Kootenai river, with a view to the control of its floods, is advisable at the present time."

Briefly the Report of the United States Corps of Engineers to the Secretary of War points out:

That the drainage districts in Idaho are subject to over-topping of the dykes during high water;

That the safeguarding of the drainage districts in Idaho from flooding out in high water is dependent upon the enlargement of the outlet of Kootenay

lake, or alternatively, the diversion of the Upper Kootenay into the Columbia river through what is known as Canal flats, or a combination of the two—both of which operations must be undertaken in Canada;

That material raising of the dikes or deepening of the channel in Idaho is infeasible;

That the reclamation areas in Idaho are at present probably subject to the possibilities of greater damage from floods during the summer season than from improper drainage of the sub-soil due to the raising of the water table during the fall and winter months;

That the use of the storage as proposed by the West Kootenay Power and Light Company is desirable for the highest utilization of the potential power in the Kootenay and the Columbia rivers, that is to say in the power reach of the Columbia river lying within the United States;

That the protection of the drainage districts by the enlargement of the lake outlet can be effected only by joint action between Canada and the United States which action can best be secured by the International Joint Commission.

United States Geological Survey. At the 1929 Hearing of the Commission the United States Geological Survey submitted a statement, which was not however formally filed as an exhibit. In this statement, after a general description of the Kootenay river drainage area, which will be found elsewhere in this report, the following description is given of the nature of the soil:—

"The alluvial deposits have formed a typical flood plain. As the material has been laid down by floods, it is self-evident that the lands so formed must lie below the heights attained by floods in the valley. As a matter of fact, in a state of nature these valley lands are subject to overflow annually to a greater or less degree. In a great flood all the lowlands would be covered, resulting essentially in a greatly enlarged Kootenai lake extending upstream to Bonners ferry. As the waters fell the lands would gradually become exposed until, when the river reached a low stage, an area of more than 35,000 acres would be uncovered on the United States side of the boundary through which the low-water channel would wind in a very tortuous course. Under these conditions a large part of this area would be but very little above the level of the water in the river. The relative altitude and area of these lands as obtained from detailed topographic surveys recently made by the Geological Survey, are shown graphically in figure 2 (in original report). The magnitude of the comparable valley area on the Canadian side is not authoritatively known. Because of their flatness the valley lands described are commonly known as the Kootenai flats or Kootenai bottoms.

"Like most alluvial lands so formed the Kootenai flats are very fertile. Bountiful crops of hay grow on those portions from which the flood waters recede early enough to permit. If the flood waters can be held back from the lands the productive area may be materially increased, and under the cultivation thus made practicable, more profitable varieties of crops may be raised. Consequently, numerous drainage districts have been formed in Idaho within the last few years to construct systems of dikes, each of which is designed to hold out the flood waters from a body of land adjoining the low-water channel of the river, suited to such reclamation as a unit. The total area included in such districts at the present time is approximately 22,000 acres. As the river water tends to seep through into the dyked areas when the stage of the river is high relatively to the land area, each district must be equipped with a system of drainage ditches and a pumping plant to collect and remove to the river such seepage waters and also any natural drainage waters that collect within the dyked areas. As the stage of the river falls a condition is reached where seepage no longer occurs and finally the level of the river becomes so low that the lands are drained into it without pumping. Of course the pumping plants need not be operated when there is no superfluous water to dispose of."

Drainage Districts. In an appendix to this statement a detailed description is given of the Drainage District enterprises. These represent an aggregate investment for construction of $1,200,000, but they have directly or indirectly created wealth that is appraised at a much greater amount. A considerable additional area can undoubtedly be reclaimed by the construction of dykes. There are also probably areas, of relatively small magnitude in the aggregate, which because of unfavourable location or form cannot practically be protected from floods. In general such lands have a value for agriculture appreciably lower than that of lands that have been or can be reclaimed.

"During the past ten years (before 1929) the reclamation of Kootenai valley in Idaho by land draining and dyking has been proceeding rapidly, somewhat in contrast to reclamation by irrigation in other sections of the state which has progressed relatively slowly.

"These reclamation enterprises are in small units. While some advantages would doubtless have resulted if larger units had been adopted, it is also true that the small unit system has made it possible to provide effective colonization of each project and has resulted in actual farm operations by large-scale methods following closely after construction. The natural richness of the soil and the favourable topography of the raw lands have hastened the period of profitable returns on these comparatively new projects."

A table was submitted showing "the progress of reclamation, the areas involved, the costs of construction, and the appraised values of the constructed drainage districts. A study of this sheet is interesting and discloses that reclamation experience in the Kootenai flats is of comparatively short duration, that the average area of the constructed districts is somewhat less than 2,500 acres, that costs of construction have been moderate, averaging somewhat less than $60 per acre, and that the appraised valuations for bonding purposes have varied from $100 to $150 per acre.

"The gross return per acre, representing the 1929 crop, has been estimated at $50 for the entire area of nearly 22,000 acres within the nine constructed districts. The progress evidenced by these apparently profitable yields compares favourably with the returns from irrigation projects older in experience. The costs of construction are considerably lower than the costs estimated for the construction of many proposed or recently constructed irrigation projects in similar climates. The present land values in Kootenai valley as appraised for bonding purposes are doubtless conservative in spite of the possibility of overflow during years of extreme floods, and these values are claimed to be considerably less than current market prices in the valley.

"Of the remaining 18,000 acres of undeveloped land above the international boundary, about 13,000 acres are probably as susceptible of profitable reclamation as the average of the developed areas. More than half of these better lands are included in organized districts prepared to proceed with construction in the near future. On basis of the rate of development of existing projects it seems reasonable to assume that most of the remaining lands will be diked within a few years leaving the least desirable lands in their natural state until the last.

"With so small an area remaining for future development, the efforts of the farmers of Kootenai Valley have turned toward more intensive farming. Heretofore, wheat and hay in general have been the staple crops but now attention is turned to the possibilities of growing potatoes, asparagus, sugar beets, lettuce, peas, and other garden products. The naturally rich soil, the favourable climatic conditions and ready marketing facilities, combine to encourage this greater diversification of crops. Some experimental work has already been done with a view to proving which varieties of crops are best adapted to the local

conditions. It is expected that successful growth of crops other than wheat and hay will require deeper drainage of the soil than is effected by the present drainage works. Some of the districts may seek lower outlet and larger pumps to effect a general lowering of the water table both during the flood season and the long low water season when gravity drainage is possible. It is not unreasonable to assume that diversification of crops in bringing greater cash returns may increase values represented in reclaimed lands to a point where the costs of increased flood protection and better drainage will be justified.

"The program for the development of the agricultural resources of Kootenai Valley in Idaho has progressed so far with considerable success. While information concerning the remaining undeveloped sections of the valley is perhaps more or less speculative, there appears to be no reason that reclamation of most of the new lands as contemplated will not be followed with about the same degree of success as experienced by the constructed projects.

"Profiles of the water surface of Kootenai river for several days have been developed from Boom Camp, Idaho, to Granite, British Columbia. The dates selected are those when the water levels in Kootenai Lake correspond more or less closely to the maximum levels of the proposed plan of operation outlined in the application of the West Kootenay Power and Light Company. Profiles illustrate average low water conditions and actual slopes observed at times when the Nelson gauge recorded 4·5 feet and 6·0 feet, respectively. Several different conditions are indicated, at or approximating the latter stage. The river slopes through the Kootenai flats are affected noticeably by the quantity of water passing down the river in relation to the stage of Kootenai lake. The profiles depict natural conditions actually observed while figure 3 represents season determinations in which the regulated cycle of water levels has been calculated. Attention is called to the fact that the average low water profile is representative of higher lake stages than those occurring during many low water seasons. Also, higher river discharges are represented in the other profiles than will occur except at rare intervals during the average storage season. . . .

"Eight profiles of the ground surface across the valley have also been developed from topographic maps at different points crossing the various drainage districts. The information on water levels has been transferred to those sheets in so far as is practicable in order that the relation between river levels and adjacent lands may be observed. The elevations of the various drain outlets are shown both in relation to land levels and river levels and a definite picture of the general situation is presented. High stages are also shown and the need for higher dikes to protect against extreme floods is indicated.

"Competent engineers have stated that complete drainage in these districts will require that outlet structures be lowered to an elevation of about 8 feet below the level of the lowest land in the district and drain ditches be lowered accordingly where necessary and where the subsoil material will permit without causing undue seepage and boils. While it is assumed that an examination of the ground surface profiles shows plainly the desirability of lowering present drain outlets and the possibility of so doing and retaining the gravity flow during the low water season, it is desired to call particular attention to this even greater lowering of drainage outlets that may be required by the program of deeper drainage and diversification of crops incident to the highest development of the lands. A table is inserted showing the relation between elevations of drainage outlets and the lowest ground as they exist at present and as would be desirable for the best use of the lands.

TABLE NO. 2

District number	Elevation bottom of outlet at inside of dike (feet)	Elevation lowest ground (feet)	Difference	Area within 8 feet of drain outlet (acres)	Suggested elevation bottom of outlet (feet)	Average low water level (unregulated) (feet)
1	1,745·1	1,748	2·9	2,130	1,740	1,742·1
2	1,755·8	1,759	3·2	300	1,751	1,742·8
3	1,748·6	1,754	5·4	310	1,746	1,741·7
4	1,751·0	1,751	0·0	2,680	1,743	1,741·1
5	1,750·7	1,753	2·3	560	1,745	1,741·6
6	1,743·0	1,748	5·0	1,050	1,740	1,740·9
7	1,747·5	1,748	0·9	1,020	1,740	1,741·9
8	1,745·0	1,750	5·0	1,920	1,742	1,740·8
9	1,748·4	1,750	1·6	480	1,742	1,741·1

"The present total fall between the lowest ground level and the bottom of the outlet gate in every district is apparently less than is desirable for the best drainage results. Instead of 8·0 feet of fall as probably needed for adequate drainage, the above table shows the constructed districts have an average fall of only 2·9 feet. The areas now being cropped within an elevation of 8·0 feet above present outlets total 10,450 acres, which represents 46 per cent of the entire area within the constructed districts. The last two columns of the table show the relative elevations of average low water and of the various outlets as suggested. It will be noted that if the outlets were lowered properly the gravity drainage would be adequate for stages at or below average low water in all drainage districts except numbers 1, 6, and 7. Reference to the individual area-elevation curves shows that the only appreciable areas of low ground (within 8 feet of average low water level) are in districts 1 and 6. It must be admitted in some cases, however, that deep drainage ditches in diked areas may prove to be a menace during flood periods unless they are located with extreme care in order that boils or blowouts through unfavorable sub-surface soil will not develop. Practically the entire area could be drained effectively by gravity during the low water season if the outlets were lowered as suggested. It is readily seen, however, that the margin between the suggested outlet elevations and average low water level is so small that the increased river levels resulting from proposed lake storage would prove damaging to the plan. With the outlets lowered as suggested, gravity drainage would be retarded in all cases except in that of district No. 2.

"An analysis of the acreage in constructed districts within 2, 4, 6 and 8 feet of the normal river stage, with 6 feet of storage water in Kootenai lake, follows in table No. 3.

TABLE NO. 3

District number	Approximate elevation of normal river stage with 6-feet storage in Kootenai Lake	Area of lands in constructed districts				
		At 6-foot normal storage level	Within 2 feet above normal storage level	Within 4 feet above 6-foot normal storage level	Within 6 feet above 6-foot normal storage level	Within 8 feet above 6-foot normal storage level
1	1,748·0	0	820	1,680	2,500	3,040
2	1,748·2	0	0	0	0	0
3	1,747·9	0	0	0	0	250
4	1,747·3	0	0	0	25	500
5	1,747·8	0	0	0	10	25
6	1,747·1	0	160	1,100	2,600	3,620
7	1,747·9	0	10	280	780	1,070
8	1,747·0	0	0	15	1,740	2,550
9	1,747·2	0	0	60	210	350
Total		0	990	3,135	7,865	11,405

The elevations of the regulated river levels adjacent to each drainage district as shown are approximately representative of normal river conditions during the period when the storage plan contemplated holding Kootenai Lake at the 6-foot level. If for any reason the river discharges above the lake are increased by heavy rains or chinooks during the storage period, the river elevations will be correspondingly increased. The magnitude of the effect during these periods depends on the rate of change of discharge as well as the duration and amount of the increased flow. Such periods of increased discharge, due to precipitation or thawing snow, are not infrequent even during fall months. The river levels may also be raised above the normal storage line by backwater effects resulting from ice obstruction in the channel. In considering the acreages in each district which lie within 2, 4, 6 and 8 feet of the proposed regulated river level, the above-mentioned possibilities should be borne in mind. Also, to aid in the comparative study, it should be remembered that the natural river elevations for the corresponding period average 3 to 4 feet lower than the regulated levels. Although no land lies below the regulated river level, 3,135 acres lie within 4 feet and 11,405 acres lie within 8 feet thereof. The table clearly shows the possibility of water-logging large areas by the proposed storage plan (of the West Kootenay Power and Light Company), particularly within districts numbers 1, 6 and 7.

Descriptions of Drainage Districts. In a report prepared by the United States Geological Survey on the Effects of Proposed Regulated Water Levels, Kootenai River, on Water Table and Drainage outlets, Kootenai Valley Drainage Districts, filed as Newell Exhibit No. 11 in connection with the Amended Application of the West Kootenay Power and Light Company, Limited, and dated June, 1933, the following descriptions are given of twelve of the thirteen drainage districts in the Kootenai valley in northern Idaho:—

"**Drainage District No. 1.** Drainage District No. 1 is located on the south side of Kootenai river immediately adjacent to Bonners Ferry. It was organized October 21, 1920, and construction followed immediately. Reclamation of the lands included the drainage of Mirror and Fry Lakes within the boundaries. District exposures to river and creek of about 4·5 miles were diked, the interior drainage system was constructed, and pumping plants installed. The district has been cropped since 1921. A small area of low land near the south end has not yet been sufficiently drained to permit cultivation. Foothill exposures on the east and south total 6·5 miles. Several rocky hills mark the bottom land topography. One of these is at the river bank and another farther south near the foothill. Although they are within the district boundaries, these areas have not been measured or considered a part of the district.

"The lowest land in the district is at elevation 1,748·2 feet and is near observation well 1-8 in south end of the district. The bottom of the river channel adjacent to the district lands has been defined at five cross sections (1930 survey) and low points were found to vary in elevation from 1,708·0 to 1,732·6 feet. The average bottom low point is at elevation 1,724·7 feet or 23·5 feet below the lowest land. The district comprises 4,424 acres (measured on topographic maps); 4,310 acres are assessed. The elevation of the land varies from 1,748·2 to 1,770 feet. Over 3,000 acres are below the 1,756 contour which incloses lands within about 10 feet in elevation of the storage line requested.

"Ground water records are available 1930 to date from 63 observation wells where water table elevations have been determined at intervals of two weeks. Readings were taken more often during the high water periods. A continuous record of water table elevation has been obtained at a special well near 1-52 by the operation of a water-stage recorder. Of the regular wells 36 are in critical, 11 are in levee and 11 are in other areas. Because of right of way difficulties several records were discontinued and all are not included in the classified

groups. The observations from each group were averaged to obtain a mean for the area they represent. Individual and average hydrographs of water table are included in Compilation of Base Data, Volume III, for the period 1930-32. (This and other material referred to herein is filed in the offices of the Commission in Ottawa and Washington).

"Logs of materials recorded when observation wells were installed show a predominance of silt and sandy loams near the surface of the ground. Peat and muck showings in this district were limited. Subsoils of sandy clay, silt combinations, sand, and clay were noted. Test holes were drilled near the south end of the district by the Great Northern Railway and extend deeper than the drillings for the observation wells. Logs of 23 holes, extending down 40 to 70 feet below an average ground surface elevation of 1,750 feet show, in general. the following: Loose peat, to soft blue clay, to blue and brown sands, to gravel. The Gunderson domestic well is about 300 feet from the river bank at a point where ground surface elevation is approximately 1,772 feet. The owner reports that an open well was dug 25 feet deep through silt and clay to coarse sand; thence a well point was driven 25 feet farther through what seemed to be river gravel. Soil samples from four locations in the district were examined and classified in the laboratory of the Ground Water Division, United States Geological Survey. Also, an analysis was made of a water sample from a shallow domestic well on the Clapp ranch. Shrinkage cracks in soil surfaces have been noted in District No. 1 within the 'critical area' which are of extraordinary width and extent, and no doubt enhance ground water movements. The soil materials in the 'critical area' are predominantly mineral.

"Critical areas in which water table was within 4 feet or less of the ground surface on April 1, 1930, within District No. 1 comprise 2,390 acres. The average depth to water table at critical wells on pertinent dates follows:—

Date	Designation	Average depth to water table (feet)
Feb. 20, 1930	Spring recharge	0·8
April 1, 1930	Spring plowing	2·0
May 1, 1930	Spring planting	2·4
Nov. 1, 1930	Beginning winter	5·7
Feb. 20, 1931	Spring recharge	2·0
April 1, 1931	Spring plowing	2·5
May 1, 1931	Spring planting	2·9
Nov. 1, 1931	Beginning winter	6·8
March 3, 1932	Spring recharge	0·4
April 1, 1932	Spring plowing	1·1
May 1, 1932	Spring planting	1·6
Nov. 1, 1932	Beginning winter	5·7

"Margins between ground surface and water table in levee and other areas are greater than those tabulated for critical areas.

"The height of the water table at planting time varies from year to year. Depth to water table contours drawn by L. T. Jessup correspond approximately to planting time. The areas in acres within five zones of depth follow:—

Date	Depth 0′–1′ (Acres)	Depth 1′–2′ (Acres)	Depth 2′–3′ (Acres)	Depth 3′–4′ (Acres)	Depth Over 4′ (Acres)
May 7, 1930	180	470	850	600	2,324
May 1, 1931	150	200	700	750	2,624
May 11, 1932	200	900	750	450	2,124

" Description of pumping equipment is included in Compilation of Base Data, Volume IV. The quantities pumped from the drainage district during these seasons have been computed as follows:—

Year	Time in hours		Total quantity, acre-feet
	16″ pump	10″ pump	
1930	320·8	657·2	818
1931	36·2	466·2	294
1932	730	1,194	1,670

"A large share of the total quantity pumped from the district was lifted to a higher ditch level at the booster pump station south of well 1-11.

" The maximum discharge measured at the pumping station, 1930-32, was 18·7 second-feet with the 16-inch pump operating and 7·9 second-feet with the 10-inch pump operating.

" The elevation of the bottom of the gravity outlet is 1,743·0 feet at the point where it discharges into Deep Creek adjacent to Kootenai river. The maximum discharge observed passing this outlet, 1931-32, was 29·3 second-feet.

"**Drainage District No. 3.** Drainage District No. 3 is located on the west side of Kootenai river, between Lost creek and Burton creek. The nearest contact is 7·7 miles by river downstream from Bonners Ferry. The date of the district organization was July 14, 1924, and the dikes and drains were constructed the following year. The district has been cropped since 1926. Not all the area, however, has been tillable, because of inadequate drainage facilities. The interior drainage system was extended in 1932 to improve conditions and the dikes near the pumping plant were rebuilt. River exposures total 3·3 miles of the 5·7 miles of district boundary.

" The lowest land in District No. 3 is at elevation 1,754·1 feet and is in the back area between wells 3-103 and 3-110. The bottom of the river channel opposite the district has been defined (1930 survey) at eight cross sections and low points were found to vary in elevation from 1,704·9 to 1,725·8 feet. The average of the bottom elevations is 1,716·9 feet or 37·2 feet below the lowest land. The total area of land within the district is 1,156 acres (measured on topographic maps) ; 1,052 acres are assessed. The elevation of the land varies from 1,754·1 to 1,770 feet; 257 acres are below the 1,756 contour which incloses lands within about 10 feet in elevation of the storage line requested.

" Ground water records are available from 13 observation wells where water table elevations have been determined at intervals of two weeks. More frequent observations were made during high water seasons. Of the wells measured, 5 are in critical, 4 in levee, and 4 in other areas. The observations from each group were averaged to obtain a mean for the area they represent. Individual and average hydrographs of water table are included in Compilation of Base Data, Volume III.

" The recorded logs of soil materials in District No. 3 show sandy loams, sandy silts, and sandy clays in the areas adjacent to the present river channel. The ' critical area ' wells show peat to a depth of 7 feet, throughout.

" Critical areas in which water table was within 4 feet or less of the ground surface on April 1, 1930, comprise 286 acres. The average depth to water table at critical wells on pertinent dates follows:—

Date	Designation	Average depth to water table (feet)
April 1, 1930	Spring plowing	(0·9)
May 1, 1930	Spring planting	0·7
Nov. 1, 1930	Beginning winter	3·1
March 4, 1931	Spring recharge	1·4
April 1, 1931	Spring plowing	1·3
May 1, 1931	Spring planting	1·8
Nov. 1, 1931	Beginning winter	4·2
March 2, 1932	Spring recharge	1·2
April 1, 1932	Spring plowing	1·4
May 1, 1932	Spring planting	1·4
Nov. 1, 1932	Beginning winter	3·2

" The first complete round of readings in District No. 3 was taken in mid April, 1930, so that the depth at the time of spring recharge was not recorded that year. The depth shown for April 1, is an approximation.

" Margins between ground surface and water table in levee and other areas are greater than those tabulated for critical areas.

" The height of the water table at planting time varies with the years. Depth to water table contours drawn by L. T. Jessup correspond approximately to planting time. The areas in acres within five zones of depth follow:—

Date	Depth 0′–1′ (Acres)	Depth 1′–2′ (Acres)	Depth 2′–3′ (Acres)	Depth 3′–4′ (Acres)	Depth Over 4′ (Acres)
April 29, 1930	235	35	35	40	811
April 29, 1931	175	35	40	40	866
May 10, 1932	240	35	35	40	806

" Description of pumping equipment is included in Compilation of Base Data, Volume IV. The quantities pumped from Drainage District No. 3 during three seasons have been computed as follows:—

Year	Time in hours		Total quantity, acre-feet
	16″ pump	6″ pump	
1930	197·6	....	141
1931	57·3	....	43
1932	849	360	695

"The old booster pump near well 3-100 was not operated during these years. Considerable difficulty was experienced at the outlet structure during the 1932 high water season and pumps were moved farther up the drain ditch. Plans were made to remove the outlet structure to a point farther from the river bank and rebuild adjacent sections of dike in advance of the 1933 season.

" The maximum discharge measured at the pumping station, 1930-32, was 10·8 second-feet with the 16-inch pump operating and 2·2 second-feet with the temporary 6-inch pump operating.

" The elevation of the bottom of the gravity outlet is 1,748·8 feet at the point where it discharges into Kootenai river. The maximum discharge observed passing this outlet, 1931-32, was 17·6 second-feet.

"**Drainage District No. 4.** Drainage District No. 4 is located on the east side of Kootenai river immediately upstream from Copeland. Organization of the district was of date, July 17, 1924, and construction followed in 1925-26. Reclamation of the lands included the diking of Mission creek against the foothill on the east. Rock creek and Brush creek, two tributary streams, were carried to Mission creek via a foothill ditch and the combined flow passed through the drainage outlet into Mission creek. This arrangement requires that the discharge of these two tributaries be pumped during the periods when the river is high enough to back up Mission creek to the outlet structure. Krause slough, near the north end of the segregation, was cut off by the river dike. District lands have been cropped since 1926. The boundary exposure to Kootenai river and Mission creek is 9 miles long and the foothill contact extends 4·7 miles within the dikes. District No. 4 is, therefore, long and narrow. It differs from the other districts in that the river dike does not follow the meander of the river bank but is shortened by cross cutting deep bends. Three tracts of land which otherwise would have been included are thus left outside its boundaries.

" The lowest land in District No. 4 is at elevation 1,751 feet and is in the area of broken topography denoting river planation. The lowest land in the back area is near well 4-147 and is at elevation 1,753·6 feet. The bottom of the river channel opposite the district has been defined (1930 survey) at 21 cross sections and the low points were found to vary in elevation from 1,659·1 to 1,722·7 feet. The average of the bottom low point elevations is 1,697·1 feet or 56·5 feet below the lowest land in the back areas. The total area of land within the district is 3,381 acres (measured on topographic maps) and the assessment list shows 3,127 acres. The elevation of the land varies from 1,751 to 1,771 feet; 1,009 acres are below the 1,756 contour which incloses lands within about 10 feet in elevation of the storage line requested.

" Ground water records are available from 31 observation wells where water table elevations have been determined at intervals of two weeks. More frequent observations were made during high water periods. Of the wells measured, 18 are in critical, 7 in levee, and 6 in other areas. The observations from each group were averaged to obtain a mean for the area they represent. Individual and average hydrographs of water table are included in Compilation of Base Data, Volume III.

" Surface soils in the 'critical area' in District No. 4 are predominantly peat. The areas adjacent to the river are largely composed of sandy clay and sandy silt combinations. No information is available concerning deeper borings in the district.

" Critical areas in which water table was within 4 feet or less of the ground surface on April 1, 1930, comprise 1,350 acres. The average depth to water table at critical wells on pertinent dates follows:—

Date	Designation	Average depth to water table (feet)
Feb. 18, 1930	Spring recharge	(1·3)
April 1, 1930	Spring plowing	(2·0)
May 1, 1930	Spring planting	(2·2)
Nov. 1, 1930	Beginning winter	5·1
Feb. 28, 1931	Spring recharge	3·8
April 1, 1931	Spring plowing	3·9
May 1, 1931	Spring planting	3·9
Nov. 1, 1931	Beginning winter	5·9
March 9, 1932	Spring recharge	2·0
April 1, 1932	Spring plowing	1·8
May 1, 1932	Spring planting	1·4
Nov. 1, 1932	Beginning winter	5·0

" Readings on only part of the wells were available prior to May 10, 1930. Depths listed prior to that date are approximations of the average.

" Margins between ground surface and water table in levee and other areas are greater than those tabulated for critical areas.

" The height of water table at planting time varies from year to year. Depth to water table contours drawn by L. T. Jessup correspond approximately to planting time. The areas in acres within five zones of depth follow:—

Date	Depth 0′–1′ (Acres)	Depth 1′–2′ (Acres)	Depth 2′–3′ (Acres)	Depth 3′–4′ (Acres)	Depth Over 4′ (Acres)
April 26, 1930	340	300	285	270	2,186
April 24, 1931	0	200	260	220	2,701
May 5, 1932	650	280	260	210	1,981

" Description of pumping equipment is included in Compilation of Base Data, Volume IV. The quantities pumped from the drainage district during three seasons have been computed as follows:—

Year	Time in hours			Total quantity, (acre-feet)
	15″ pump	12″ pump	8″ pump	
1930	532·0	290·2	....	646
1931	72·8	72·8	....	102
1932	1,176	800	72·0	1,736

" The pumped quantities necessarily include the flow of Rock and Brush creeks during the period. A small share of the quantities pumped in 1930 and 1932 were lifted into the foothill drain by a booster pump. The temporary pumping station at the river dike (mile 19·48) was not operated during the years 1930-32. A freshet in the tributary streams overtopped the banks of the foothill ditch for a short period in 1932 when the capacity of the gravity outlet was insufficient.

" The maximum discharge measured at the pumping station, 1930-32, was 22·8 second-feet when the 15-inch and 12-inch pumps were operating as a unit. The maximum discharge of the temporary 8-inch pump was 6·4 second-feet.

" The elevation of the bottom of the gravity outlet is 1,750·40 feet at the point where it discharges into Mission creek, 1·75 miles upstream from where the creek joins Kootenai river. The maximum discharge observed passing this outlet 1931-32 was 51·8 second-feet.

"**Drainage District No. 5.** Drainage District No. 5 is located on the east side of Kootenai river opposite the mouth of Ball creek, a tributary stream entering the river from the west. It is reached directly from Bonners Ferry by the foothill road which skirts consecutively Districts Nos. 11 and 5. The distance by this road from Bonners Ferry to the nearest contact with district lands is 6·5 miles. The district was organized December 13, 1924, and construction was completed the following year. Fleming creek enters the valley within the district boundaries and its flow has been confined to a foothill drainage ditch leading to the pumping station and gravity outlet one-half mile below. The tract has been controlled by Mr. Klockmann and operated as a single unit; it has been cropped since 1925. The river dike failed in 1928, resulting in inundation and crop loss. The river exposure totals 2·9 miles and the foothill contact within the boundaries is 1·6 miles long. The cross dike between Districts Nos. 5 and 11 is the joint property of the respective organizations.

"The lowest land in the district is at elevation 1,753·2 and is located between levee and critical areas. The lowest land in the back area is at elevation 1,755·4 and is near the south end of the district. The bottom of the river channel opposite the district has been defined (1930 survey) at six cross sections and low points were found to range in elevation from 1,678·2 to 1,726·8 feet. The average of the bottom low point elevations is 1,710·0 feet or 45·4 feet below the lowest land in the back area. The total area of land within the district is 983 acres (measured on topographic maps); the assessment list shows 906 acres. The elevation of the land varies from 1,753·2 to 1,770·0 feet; only 25 acres are below the 1,756 contour which incloses lands within about 10 feet in elevation of the storage line requested.

"Ground water records are available from 11 observation wells where water table elevations have been determined at intervals of two weeks. More frequent observations were made during the high water periods. Of the wells measured 3 are in critical, 4 in levee and 3 in other areas. The remaining well 5-122A was operated as a duplicate of 5-122 to give comparison between two types of installation. Individual and average hydrographs of water table are included in Compilation of Base Data, Volume III, for the period 1930-1932.

"Logs of materials recorded when observation wells were installed show sandy loams and silt loams near the surface with combinations of sand, silt, and clay underlying. The 'critical area' soils are practically all peats and peat loams. A small section of the peat area near well 5-118 suffered from peat fire during the period of the investigation.

"Critical areas in which water table was within 4 feet or less of the ground surface on April 1, 1930, comprise 446 acres. The average depth to water table at critical wells on pertinent dates follows:—

Date	Designation	Average depth to water table (feet)
Feb. 21, 1930	Spring recharge	1·7
April 1, 1930	Spring plowing	3·0
May 1, 1930	Spring planting	3·7
Nov. 1, 1930	Beginning winter	8·4
March 3, 1931	Spring recharge	6·9
April 1, 1931	Spring plowing	7·4
May 1, 1931	Spring planting	(7·4)
Nov. 1, 1931	Beginning winter	8·4
Feb. 29, 1932	Spring recharge	2·8
April 1, 1932	Spring plowing	2·9
May 1, 1932	Spring planting	3·5
Nov. 1, 1932	Beginning winter	7·5

"Margins between ground surface and water table in levee and other areas are greater than those tabulated for critical areas.

"The heights of water table at planting time vary from year to year. Depth to water table contours drawn by L. T. Jessup correspond approximately to planting time. The areas in acres within five zones of depth follow:—

Date	Depth 0′–1′ (Acres)	Depth 1′–2′ (Acres)	Depth 2′–3′ (Acres)	Depth 3′–4′ (Acres)	Depth Over 4′ (Acres)
April 29, 1930	0	50	150	85	698
April 28, 1931	0	0	0	50	933
April 23, 1932	40	140	95	75	633

"Description of pumping equipment is included in Compilation of Base Data, Volume IV. The quantities pumped from the drainage district during three seasons have been compiled as follows:—

Year	Time in hours		Total quantity, (acre-feet)
	14″ pump	10″ pump	
1930	115·7		105
1931	16·6		14
1932	314	252	422

"The pumped quantities include the flow of Fleming creek during the period.

"The maximum discharge measured at the pumping station, 1930-32, was 12·3 second-feet with the 14-inch pump operating. The maximum discharge of the temporary 10-inch pump was 7·4 second-foot.

"The elevation of the bottom of the gravity outlet is 1,749·50 feet at the point where it discharges into a large channel leading to Kootenai river. The maximum discharge observed passing this outlet, 1931-32, was 6·7 second-feet.

"**Drainage District No. 6.** Drainage District No. 6 is located on the east side of Kootenai river below Mission creek and Copeland post office. It was organized August 14, 1925, and construction was completed the following year. Eneas and Cedar creeks enter the valley within the boundaries of the district and the flow is confined to the interior drainage system. Lucas creek, a bottoms channel, has been improved and now gathers the flow from the drain ditches and carries it to the gravity outlet and pumping station near the north end of the district. The Andrews and Jerome sloughs were cut off by the river dike. Another slough channel near the foothill at the south end of the district was cut off from Mission creek by the cross dike following the north bank of the creek from the foothill to the river. The tract of land reclaimed is larger than that in any other district and has been cropped since 1927. During the first season of operation, the river dike failed at point where it crossed the Jerome slough channel and the district was inundated. Improvements in interior drainage system were then made and broken dikes repaired. The district is exposed to river and creek for almost 10 miles and is divided from District No. 8 on the north by a cross dike one-half mile long.

"The lowest land in District No. 6 is at elevation 1,748·4 feet and is in the back area near well 6-225A. The bottom of the river channel opposite the district has been defined (1930 survey) at 20 cross sections and low points were found to range in elevation from 1,668·6 to 1,715·9 feet. The average bottom low point elevation is 1,702·6 feet or 45·8 feet below the lowest land. The total area of land within District No. 6 is 5,601 acres (measured on topographic maps) and the assessment list shows 5,352 acres. The elevation of the land varies from 1,748·4 to 1,771 feet; 3,932 acres are below the 1,756 contour which incloses lands within about 10 feet in elevation of the storage line requested.

"Ground water records are available from 49 observation wells where water table elevations have been determined at intervals of two weeks. More frequent observations were made during high water periods. A continuous record of water table elevation has been obtained at a special well near 6-179B by the operation of a water-stage recorder. Of the regular wells, 13 are in critical, 13 are in levee, and 23 are in other areas. The observations from each group were averaged to obtain a mean for the area they represent. Individual and average hydrographs of water table for the period 1930-1932 are included in the Compilation of Base Data, Volume III.

"The soil materials in District No. 6 are largely silt and sandy loams with silty clay mixtures. Peat occurs to a limited degree only. Shrinkage cracks

were particularly noticeable in the old lake bottom areas. A deep well located in Doyle's bend about 1,000 feet from the river bank is reported to have been driven 130 feet by hand methods. The sand point clogged and the entire length of pipe was withdrawn. The owner states that blue clay and fine sand were noted in the pipe joints. The water supply was abandoned because it was mineralized and had an unpleasant taste. A sample of the water was collected and analyzed. Deepening some of the observation wells near the old Lucas creek channel was reported difficult because of striking rocks or gravel formation. Soil samples from four locations in the district were examined and classified in the laboratory of the Ground Water Division.

" Critical areas in which water table was within 4 feet or less of the ground surface on April 1, 1930, comprise 860 acres. The average depth to water table at critical wells on pertinent dates follows:—

Date	Designation	Average depth to water table (feet)
March 3, 1930	Spring recharge	(2·0)
April 1, 1930	Spring plowing	2·4
May 1, 1930	Spring planting	3·2
Nov. 1, 1930	Beginning winter	9·1
March 10, 1931	Spring recharge	5·7
April 1, 1931	Spring plowing	5·8
May 1, 1931	Spring planting	6·1
Nov. 1, 1931	Beginning winter	9·8
March 21, 1932	Spring recharge	2·7
April 1, 1932	Spring plowing	2·6
May 1, 1932	Spring planting	2·6
Nov. 1, 1932	Beginning winter	8·8

" Readings on only part of the wells were available prior to April 1, 1930. Depth listed for March 3, 1930, is an approximation of the average.

" Margins between ground surface and water table in levee and other areas are greater than those tabulated for critical areas.

" The height of water table at planting time varies from year to year. Depth to water table contours drawn by L. T. Jessup correspond approximately to planting time. The areas in acres within five zones of depth follow:—

Date	Depth 0′–1′ (Acres)	Depth 1′–2′ (Acres)	Depth 2′–3′ (Acres)	Depth 3′–4′ (Acres)	Depth Over 4′ (Acres)
April 26, 1930	0	10	190	660	4,741
April 23, 1931	0	0	10	20	5,571
April 19, 1932	0	80	470	550	4,501

" Description of pumping equipment is included in Compilation of Base Data, Volume IV. The quantities pumped from the Drainage District No. 6 during three seasons have been computed as follows:—

Year	Time in hours	Total quantity (acre-feet)
	15″ pump	
1930	189·8	183
1931	56·0	57
1932	552·0	513

"The maximum discharge measured at the pumping station, 1930-32, was 12·9 second-feet with the 15-inch pump operating.

"The elevation of the bottom of the gravity outlet is 1,742·8 feet at the point where it discharges into Kootenai river at the mouth of Lucas creek channel. The maximum discharge observed passing this outlet, 1931-32, was 17·6 second-feet.

"**Drainage District No. 7.** Drainage District No. 7 is located on the west side of Kootenai river below Deep creek. It is reached by road through District No. 1 and the nearest contact is about 3·5 miles from Bonners Ferry. It was organized September 14, 1925, but construction was not completed until 1928. Reclamation of the land included the diking of Myrtle creek close along the western foothill to a junction with the river, outside the district boundaries. Interior drains were constructed which lead to a section of the old Myrtle creek channel and drainage outlet and pumping plant was installed where the creek dike crossed it, a mile upstream from the river. The district has made several changes in pumping equipment since the original installation and has extended the lateral drains at both ends of the tract to improve water table conditions. Eight miles of the district boundaries are exposed to Kootenai river and tributary streams. The reclaimed lands have been cropped since 1929.

"The lowest land in District No. 7 is at elevation 1,748·4 feet and lies on the west side of the drain between wells 7-62 and 7-70. The bottom of the river channel has been defined (1930 survey) at 7 cross section points adjacent to the district and low point elevations have been found to vary from 1,705·9 to 1,725·0 feet. The average of the bottom low point elevations is 1,720·7 or 27·7 feet below the lowest land. The district comprises 2,165 acres (measured on topographic maps) and the assessment list shows 2,133 acres. The elevation of the land varies from 1,748·4 to 1,775·0 feet; 1,080 acres are below the 1,756 contour inclosing lands within about 10 feet in elevation of the storage line requested.

"Ground water records are available, 1930-32, from 32 observation wells where water table elevations have been determined at intervals of two weeks. Readings were taken more often during high water season. Of these wells, 12 are in critical, 9 are in levee, and 11 are in other areas. The observations for each group were averaged to obtain a mean for the area which they represent. Individual and average hydrographs of water table for the period 1930-32 are included in Compilation of Base Data, Volume III.

"The logs of materials encountered when the observation wells were installed show sandy loams and silt loams to predominate. Peat soils are not so extensive as in some of the other districts. Sand layers were recorded at lower levels in several holes. Three domestic wells were canvassed in levee areas. They were reported to have been driven to depths of about 50 feet. Little information on materials encountered is available. Two of the wells furnish continuous supplies and a third has given difficulty because of the sand screen clogging. A sample of the water from the Brockly well was analyzed. Soil samples from two locations in the district were examined and classified in the laboratory of the Ground Water Division. Soils in the 'critical area' are classified roughly, three-fourths silt and sandy loams and one-fourth peat loam mixtures.

" Critical areas in which water table was within 4 feet or less of the ground surface on April 1, 1930, comprise 869 acres. The average depth to water table at critical wells on pertinent dates follows:—

Date	Designation	Average depth to water table (feet)
Feb. 19, 1930	Spring recharge	0·5
April 1, 1930	Spring plowing	1·5
May 1, 1930	Spring planting	1·9
Nov. 1, 1930	Beginning winter	5·0
Feb. 18, 1931	Spring recharge	2·0
April 1, 1931	Spring plowing	2·8
May 1, 1931	Spring planting	3·4
Nov. 1, 1931	Beginning winter	5·2
Mar. 1, 1932	Spring recharge	0·6
April 1, 1932	Spring plowing	1·1
May 1, 1932	Spring planting	1·4
Nov. 1, 1932	Beginning winter	3·8

" Margins between ground surface and water table in levee and other areas are greater than those tabulated for critical area.

" The height of the water table at planting time varies from year to year. Depth to water table contours drawn by L. T. Jessup correspond approximately to planting time. The areas in acres within five zones of depth follow:—

Date	Depth 0′–1′ (Acres)	Depth 1′–2′ (Acres)	Depth 2′–3′ (Acres)	Depth 3′–4′ (Acres)	Depth Over 4′ (Acres)
April 30, 1930	60	340	340	110	1,315
May 1, 1931	0	80	330	200	1,555
April 25, 1932	260	440	200	100	1,165

" Description of pumping equipment is included in the Compilation of Base Data, Volume IV. The quantities pumped from the drainage district during three seasons have been computed as follows:—

Year	Time in hours		Total quantity (acre-feet)
	Old 12″ pump	New 12″ pump	
1930	255·4	53·9	174
1931	....	95·0	61
1932	....	1,628·0	945

" The maximum discharge measured at this station, 1930-32, was 8·3 second-feet with the new 12-inch pump only operating.

" The elevation of the bottom of the gravity outlet is 1,745·9 feet at the point where it discharges into Myrtle creek one mile upstream from the point where the creek joins Kootenai river. The maximum discharge observed passing this outlet, 1931-32 was 7·8 second-feet.

"**Drainage District No. 8.** Drainage District No. 8 is located on the east side of Kootenai river immediately south of the international boundary and adjacent to Port Hill. It was organized January 2, 1926, and constructed during the same year. Reclamation of the lands included the construction of two main drainage systems discharging into Kootenai river through independent outlets at the north end of the district. Arrangements were made to permit pumping at each of these points. A dike was constructed along the river from Port Hill upstream to the north end of the District No. 6 dike comprehend-

ing a river exposure of seven miles. About a half mile of cross dike separates the lands of District No. 8 from those of District No. 6 and completes the enclosure. Almost the whole tract of land included is operated in a single unit. The lands have been cropped since 1927. The foothill exposure is 2·5 miles long and tributary streams entering from the hillside area are limited to small courses, the flow in which is intermittent in character.

"The lowest land in District No. 8 is at elevation 1,750·2 feet and is in the back area between well 8-269 and the foothill. The bottom of the river channel opposite the district has been defined at 12 cross sections (1930 survey) and the low points vary from 1,678·3 to 1,714·0 feet. The average bottom low point elevation is 1,702·3 or 47·9 feet below the lowest land. The total area within the district is 2,921 acres (measured on topographic maps) and the assessment list shows 2,669 acres. The elevation of the land varies from 1,750·2 to 1,770·0 feet; 2,670 acres are below the 1,756 contour which incloses lands within about 10 feet in elevation of the storage line requested. The topography is very flat as almost 2,000 acres are included within a range in elevation of 2 feet.

"Ground water records are available, 1930-32, from 43 observation wells where water table elevations have been determined at intervals of two weeks. More frequent observations were made during the high water period. Of these wells 19 are in critical, 15 are in levee, and 8 are in other areas. Two wells were excluded from the classifications. The observations from each of the three groups were averaged to obtain a mean for the area they represent. Individual and average hydrographs of water table for the period 1930-32 are included in Compilation of Base Data, Volume III.

"The soils of the 'critical area' in District No. 8 are practically all peat and peat loams underlaid by finer materials. The areas immediately adjacent to the river channel are composed of silt loams and sandy loams. Other areas show mixtures of these classes with peat and clay. In so far as the surface soils are concerned peat is the predominant soil class while the subsoils may be said to be generally of fine texture as above described. Two deeper domestic wells near the south end of the district were canvassed. They are reported to be 70 and 100 feet deep, respectively, and to have been driven by hand methods. A sample of water from the former was analyzed. A shallow dug well was noted along the foothill road. Soil samples from two locations in the district were examined and classified in the laboratory of the Ground Water Division.

"Critical areas in which water table was within 4 feet or less of the ground surface on April 1, 1930, comprise 1,230 acres. The average depth to water table at critical wells on pertinent dates follows:—

Date	Designation	Average depth to water table (feet)
March 10, 1930	Spring recharge	2·0
April 1, 1930	Spring plowing	2·2
May 1, 1930	Spring planting	2·7
Nov. 1, 1930	Beginning winter	6·3
Feb. 23, 1931	Spring recharge	3·0
April 1, 1931	Spring plowing	3·3
May 1, 1931	Spring planting	3·6
Nov. 1, 1931	Beginning winter	7·5
March 5, 1932	Spring recharge	2·3
April 1, 1932	Spring plowing	2·1
May 1, 1932	Spring planting	2·4
Nov. 1, 1932	Beginning winter	....

"Margins between ground surface and water table in levee and other areas are greater than those tabulated for the critical area.

"The height of water table at planting time varies from year to year. Depth to water table contours drawn by L. T. Jessup correspond approximately to planting time. The areas in acres within five zones of depth follow:—

Date	Depth 0′–1′ (Acres)	Depth 1′–2 (Acres)	Depth 2′–3′ (Acres)	Depth 3′–4′ (Acres)	Depth Over 4′ (Acres)
April 25, 1930	0	90	690	460	1,681
May 4, 1931	0	10	250	680	1,981
April 24, 1932	30	470	1,100	450	871

"Description of pumping equipment is included in Compilation of Base Data, Volume IV. The quantities pumped from the Drainage District No. 8 during three seasons have been computed as follows:—

Year	Time in hours		Total quantity (acre-feet)
	8″ pump	6″ pump	
1930	90	....	25
1931	....	....	0
1932	....	54	6·5

"Booster pump operated 62 hours in 1932 and pumped 6·3 acre-feet. The maximum discharge computed for the main pumps, 1930-32, was 3·3 second-feet and 1·5 second-feet, respectively.

"District No. 8 has two drainage outlets, one at Port Hill, and one about 1¼ mile west. The elevation of the bottom of the gravity outlet at Port Hill is 1,744·6 feet at the point where it discharges into Kootenai river. The corresponding elevation for the west outlet is 1,743·3 feet. The maximum discharge observed passing the Port Hill outlet, 1931-32, was 0·8 second-foot.

"**Drainage District No. 9.** Drainage District No. 9 is located on the west side of Kootenai river opposite Copeland. It was organized February 6, 1926, and dikes and drains were constructed in 1926-27. The drainage laterals with the exception of the foothill ditch are led into Kerr Lake, a small body of water which has not been entirely drained out. The slough courses which originally gathered the run-off from this tract to the lake and thence south along the foothill to the river were cut off by a short section of cross dike. A new outlet was then constructed from the lake northward to the point at the northwest corner of the tract where the gravity outlet was installed. The foothill slough was likewise reversed and extended to the same outlet. The district is confined in a major loop of the river and 3·9 miles of the boundary is thereby exposed. River banks on this loop were naturally high and high dikes were not required. The lands have been farmed since 1927.

"The lowest land in the district is at elevation of about 1,750 feet and is located around the margins of Kerr lake. The bottom of the river channel opposite the district has been defined at 5 cross sections (1930 survey) and the low points vary from 1,676·5 to 1,721·6 feet. The average bottom low point is 1,703·9 or 46·1 feet below the lowest land. The total area within the district is 1,025 acres (measured on topographic maps) and the assessment list shows 941 acres. The elevation of the lands vary from 1,750 to 1,767 feet; 420 acres are below the 1,756 contour which incloses lands within about 10 feet in elevation of the storage line requested.

" Ground water records are available, 1930-32, from 9 observation wells where water table elevations have been determined at intervals of two weeks. More frequent observations were made during the high water period. Of these wells, 5 are in levee, and 4 are in other areas. The ' critical area ' classification was so inconsequential in extent that no ground water representation is available. The observations from the groups in the levee and other areas were averaged to obtain a mean representation. Individual and average hydrographs of water table for the period 1930-32 are included in Compilation of Base Data, Volume III.

" Soils in this district are composed of sandy loams, silt loams, and clay mixtures. Logs of materials encountered in the installation of observation wells do not show any peat or peat mixtures. Shrinkage cracks were noted in the vicinity of Kerr lake.

" To show the trend of the water table, in the absence of critical area representation, the average depth to water table at all wells in the district are tabulated on pertinent dates.

Date	Designation	Average depth to water table (feet)
May 1, 1930	Spring planting	13·7
June 30, 1930	Highest level	8·7
Jan. 21, 1931	Lowest level	18·1
May 1, 1931	Spring planting	16·3
July 1, 1931	Highest level	11·1
Feb. 12, 1932	Lowest level	17·5
May 1, 1932	Spring planting	11·9
June 21, 1932	Highest level	3·8
Dec. 17, 1932	Last date compiled	13·8

" The water table in District No. 9 is very responsive to changes in river level. Water table tops the ground surface in many places during the season of high river stages.

" Description of pumping equipment is included in Compilation of Base Data, Volume IV. During the years 1930, 1931, and 1932, practically no pumping was done. The 8-inch pump was conditioned in 1932 and operated for a period of 8 hours. The total quantity pumped was computed as 2·2 acre-feet.

" The elevation of the bottom of the gravity outlet is 1,748·0 feet at the point where it discharges into Kootenai River near the northeast corner of the district. During the years 1931 and 1932 discharge at the drainage outlet was at no time observed.

"**Drainage District No. 10.** Drainage District No. 10 is located on the west side of Kootenai river between Parker creek and Long Canyon creek. It was organized May 14, 1927, and construction work was practically completed in 1930. Reclamation of the lands involved the excavation of a new channel for Parker creek and the construction of a diversion dam across the original creek bed. Interior drainage systems have two outlets, one at the north end of the district where the pumping plant was installed and the other, an auxiliary, at the point where Parker creek originally entered the river. The lands have been cropped since 1930 with the exception of parts not yet sufficiently drained to permit cultivation. The boundary of the tract is exposed to river and creek front for a distance of 5·5 miles along which dikes have been constructed. The foothill exposure extends about 2·8 miles within the diked area.

" The lowest land in the district is at elevation 1,751·5 feet and is in an area of broken topography near the pumping station. The lowest land in the back

area is at elevation 1,752·1 feet and is near well 10-228. The bottom of the river channel opposite the district has been defined (1930 survey) at 13 cross sections and low points were found to range in elevation from 1,678·3 to 1,715·9 feet. The average bottom low point elevation is 1,701·7 feet or 50·4 feet below the lowest land in the back area. The total area of land within the district is 1,633 acres (measured on topographic maps); assessment list calls for 1,676 acres. Severns Bend segregation includes 241 acres additional which, although adjacent to District No. 10, is not considered a part of it. Within the two tracts 879 acres are below the 1,756 contour which incloses lands within about 10 feet in elevation of the storage line requested. The elevation of the lands in these two segregations varies from 1,751·5 to 1,770·0 feet.

" Ground water records are available from 14 observation wells where water table elevations have been determined at intervals of two weeks. Readings were taken more often during high water periods. Of these wells 10 are in critical, and 4 are in levee areas. The observations from each group were averaged to obtain a mean for the area they represent. Individual and average hydrographs of water table for the period 1930-32 are included in the Compilation of Base Data, Volume III.

" Logs of materials recorded when observation wells were installed show silt loams, sandy loams, silty clay mixtures and peat. The larger part of the critical area is composed of peat and muck which in some cases is reported to be overlaid with loam. The peat layers are thick as indicated by the fact that the majority of the observation well holes did not pierce through the peat layers. Soil samples from a point near Severn's cross dike were examined and classified in the laboratory of the Ground Water Division. A peat fire was experienced during the fall of 1931 near the Parker creek drain.

" Critical areas in which water table was within 4 feet or less of the ground surface on April 1, 1930, comprise 958 acres. The average depth to water table at critical wells on pertinent dates follows:—

Date	Designation	Average depth to water table (feet)
April 1, 1930	Spring plowing	(1·1)
May 1, 1930	Spring planting	1·6
Nov. 1, 1930	Beginning winter	6·1
March 13, 1931	Spring recharge	3·0
April 1, 1931	Spring plowing	3·2
May 1, 1931	Spring planting	3·6
Nov. 1, 1931	Beginning winter	7·2
April 1, 1932	Spring plowing	2·3
April 8, 1932	Spring recharge	2·0
May 1, 1932	Spring planting	2·5
Nov. 1, 1932	Beginning winter	7·4

" The first full round of ground water observations in this district was completed April 28, 1932. Average depth to water table shown in the above table for April 1, 1930, is an approximation based on readings from part of the wells.

" It is very important to note that spring recharge occurs at a later date in this district and in District No. 13 than in the neighbouring areas. The time available for improving water table conditions after recharge and before high river stages ensue is very short.

" Margins between ground surface and water table in levee area are greater than those listed for the critical area.

"The height of water at planting time varies from year to year. Depth to water table contours drawn by L. T. Jessup correspond approximately to planting time. The areas in acres within five zones of depth follow:—

Date	Depth 0′–1′ (Acres)	Depth 1′–2′ (Acres)	Depth 2′–3′ (Acres)	Depth 3′–4′ (Acres)	Depth Over 4′ (Acres)
May 5, 1930	340	260	210	170	653
May 8, 1931	0	290	230	180	933
May 7, 1932	280	220	210	170	753

"Descriptions of pumping equipment are included in the Compilation of Base Data, Volume IV. The quantities pumped from Drainage District No. 10 during three seasons have been computed as follows:—

Year	Time in hours		Total quantity (acre-feet)
	10″ pump	6″ pump	
1930	1,188·0	....	711
1931	197·8	....	126
1932	1,216·0	180	731

"The maximum discharge measured at this station, 1930-32, with the 10-inch pump operating was 8·6 second-feet.

"The elevation of the bottom of the main gravity outlet is 1,746·2 feet at the point where it discharges into Kootenai river; the bottom of the auxiliary outlet is at elevation 1,748·4 feet. The maximum discharge observed passing main outlet, 1931-32, was 6·3 second-feet. At that time 1·8 second-feet was measured at the auxiliary outlet.

"**Drainage District No. 11.** Drainage District No. 11 is located on the north side of Kootenai river immediately adjacent to Bonners Ferry. It was organized December 21, 1929, and construction was advanced sufficiently to permit cultivation of a large part of the lands during the season of 1930. Reclamation plans included extending a dike along the river exposure for a distance of 8·3 miles, from the eastern boundary of the district to a contact with the District No. 5 river dike. Purchase of an interest in the cross dike of the latter district and construction of a short section at the eastern extremity inclosed the tract. Interior drainage system and gravity outlet structure were constructed. The former extended to Ferbrach and Mission lakes. The latter was located at the point where the river dike cut off Wall creek near the north end of the segregation. Mission Hill is within the boundaries of the district but has not been included in the area determinations. The reclaimed lands have been cropped since 1930.

"The lowest land in the district is at elevation 1,754·1 feet and lies in the back area near well 11-102. The bottom of the river channel has been defined (1930 survey) at 18 cross sections adjacent to the district and low point elevations have been found to vary from 1,698·9 to 1,732·6 feet. The average of the bottom low point elevations is 1,720·4 feet or 33·7 feet below the lowest land. The district comprises 4,294 acres (measured on topographic maps); the assessment list shows 4,171 acres. The elevation of the lands varies from 1,754·1 to 1,772·0 feet; 479 acres are below the 1,756 contour inclosing lands within about 10 feet in elevation of the storage line requested.

" Ground water records are available, 1930-32, from 20 observation wells where water table elevations have been determined at intervals of two weeks. Readings were taken more often during the high water periods. Of these wells, 10 are in critical, 4 in levee, and 4 in other areas. The observations in each group were arranged to obtain a mean for the area which they represent. Two wells were excluded from the grouping because of proximity to others which had been selected. Individual and average hydrographs of water table for the period 1930-32 are included in Compilation of Base Data, Volume III.

" The soils in District No. 11 are largely sandy loam, silt loam, and peat. Samples from several locations were examined and classified in the laboratory of the Ground Water Division. A deep well has been drilled by the United States Indian Service on Mission Hill at a point where the ground surface elevation is approximately 1,780 feet. According to Superintendent Byron A. Sharp, the well was originally drilled through 7 feet of surface soil followed by 78 feet of solid rock with the exception of a shallow stratum of sand and another of gravel formation. Later drilling reached a depth of 200 feet with granite encountered which changed in colour from gray to yellowish brown. An analysis of the water from this well is available. Practically all of the " critical area " surface soil is organic in character.

" Critical areas in which the water table was within 4 feet or less of the ground surface on April 1, 1930, comprise 2,060 acres. The average depth to water table at critical wells on pertinent dates follows:—

Date	Designation	Average depth to water table (feet)
April 1, 1930	Spring plowing	(2·1)
May 1, 1930	Spring planting	3·0
Nov. 1, 1930	Beginning winter	7·1
March 3, 1931	Spring recharge	5·3
April 1, 1931	Spring plowing	5·8
May 1, 1931	Spring planting	6·1
Nov. 1, 1931	Beginning winter	8·6
Feb. 29, 1932	Spring recharge	2·3
April 1, 1932	Spring plowing	3·2
May 1, 1932	Spring planting	3·4
Nov. 1, 1932	Beginning winter	8·3

" The first complete round of well observations in District No. 11 was made on April 3, 1930. The average depth to water table listed above for April 1, 1930, is an approximation.

" Margins between ground surface and water table in levee and other areas are greater than those tabulated for critical area.

" The height of the water table at planting time varies from year to year. Depth to water table contours drawn by L. T. Jessup correspond approximately to planting time. The areas in acres within five zones of depth follow:—

Date	Depth 0′–1′ (Acres)	Depth 1′–2′ (Acres)	Depth 2′–3′ (Acres)	Depth 3′–4′ (Acres)	Depth Over 4′ (Acres)
April 29, 1930	130	230	560	640	2,734
April 28, 1931	0	0	0	180	4,114
April 23, 1932	90	150	540	660	2,854

"Description of pumping equipment is included in the Compilation of Base Data, Volume IV. The quantities pumped from Drainage District No. 11 during three seasons at the temporary pumping station have been computed as follows:—

Year	Time in hours	Total quantity (acre-feet)
	10″ pump	
1930	40·0	18
1931	0·0	0
1932	0·0	0

"Booster pump operated 38 hours in 1932 and pumped 1·9 acre-feet.

"The elevation of the bottom of the gravity outlet is 1,742·5 feet at the point where it discharges into Kootenai river. The maximum discharge observed passing this outlet, 1931-32, was 4·9 second-feet.

"**Drainage District No. 12.** Drainage District No. 12 is located on the west side of Kootenai river between Ball creek and Trout creek. It is reached by road from Bonners Ferry through Districts Nos. 1, 7, and 3, the nearest contact being about 12 miles by river from town. Construction of dikes and drains was advanced sufficiently to permit cultivation of a large part of the area during 1930. Completion of the interior drainage system and installation of main pumping plant and gravity outlet was in progress the following year. The foothill ditch extends from the centre cross drain, south to the Ball creek fan, and north to the extreme end of the segregation. The cross drain carries the flow from both directions directly across the district to the main pumping plant and gravity outlet. An auxiliary outlet and temporary pump were installed at the north cross dike adjacent to Trout Creek. The district boundary is exposed to the river for a distance of 5·5 miles and to the foothill for 3·0 miles. Not all the lands within the boundaries have been placed in cultivation to date.

"The lowest land in the district is at elevation 1,751 feet and is in the area of broken topography near the south end; the lowest land in the back areas is at elevation 1,754·5 feet and lies near observation well 12-128. The bottom of the river channel adjacent to the district lands has been defined at 10 cross sections (1930 survey) and low points were found to vary in elevation from 1,693·7 to 1,726·8 feet. The average bottom low point is at elevation 1,710·6 feet or 43·9 feet below the lowest land in the back areas. The district comprises 2,187 acres (measured on topographic maps); 2,002 acres are assessed. The elevation of the lands varies from 1,751 to 1,770 feet. Only 258 acres are below the 1,756 contour inclosing lands within about 10 feet in elevation of the storage line requested.

"Ground water records are available 1930 to date from 7 observation wells where water table elevations have been determined at intervals of two weeks. Readings were taken more often during high water periods. Of these wells, 5 are in critical, and 2 in levee areas. The observations from each group have been averaged to obtain a mean for each area. The number of observation points was insufficient to develop representative water table conditions. Individual and average hydrographs of water table for the period 1930-32 are included in the Compilation of Base Data, Volume III.

"Few logs of materials are available to show classification of soils in areas adjacent to the river. Two holes show sandy clay mixtures. Soils in the 'critical area' are largely peat and peat loams underlaid with finer materials.

" Critical areas in which water table was within 4 feet or less of the ground surface on April 1, 1930, comprise 940 acres. The average depth to water table at critical wells on pertinent dates follows:—

Date	Designation	Average depth to water table (feet)
April 1, 1930	Spring plowing	(0·5)
May 1, 1930	Spring planting	0·5
Nov. 1, 1930	Beginning winter	5·5
March 14, 1931	Spring recharge	1·9
April 1, 1931	Spring plowing	2·3
May 1, 1931	Spring planting	3·3
Nov. 1, 1931	Beginning winter	7·7
March 12, 1932	Spring recharge	1·1
April 1, 1932	Spring plowing	1·2
May 1, 1932	Spring planting	1·8
Nov. 1, 1932	Beginning winter	9·6

" The first complete round of well readings in District No. 12 was made on April 16, 1930. Depth listed for April 1, 1930, is an approximation.

" Margins between ground surface and water table in levee areas, although defined at only two observation wells, are believed greater than those tabulated for critical areas.

" The height of water table at planting time varies from year to year. Depth to water table contours drawn by L. T. Jessup correspond approximately to planting time. The areas in acres within five zones of depth follow:—

Date	Depth 0′–1′ (Acres)	Depth 1′–2′ (Acres)	Depth 2′–3′ (Acres)	Depth 3′–4′ (Acres)	Depth Over 4′ (Acres)
April 28, 1930	490	160	110	100	1,327
May 9, 1931	0	180	270	190	1,547
May 9, 1932	100	400	210	150	1,327

" Descriptions of pumping equipment are included in Compilation of Base Data, Volume IV. The quantities pumped from Drainage District No. 12 during three seasons have been computed as follows:—

Year	Time in hours			Total quantity (acre-feet)
	10″ pump	8″ pump	8″ pump (temp.)	
1930	....	....	155·0	41
1931	....	....	213·9	52
1932	1,390	1,515	422·0	1,162

" The 8-inch temporary pump was in service at several different locations in the district during the three years of operation.

" The maximum discharge computed, 1930-32, with the three pumps operating independently totals 12·8 second-feet.

" The elevation of the bottom of the gravity outlet at the main pumping station is 1,748·8 feet at the point where it discharges into Kootenai river. The elevation of the bottom of the auxiliary outlet is 1,751·1 feet at the point where it discharges into Trout creek. The maximum discharge observed passing the main drain outlet, 1931-32, was 8·1 second-feet.

"**Drainage District No. 13.** Drainage District No. 13 is located on the west side of Kootenai river above Parker creek. It is reached from Copeland by ferry and road through District No. 9. It was organized August 30, 1930, and was constructed in 1930 and 1931. Reclamation works include 3·5 miles of dikes on the river exposure and about 0·5 mile on the Parker creek exposure. The main pumping station and gravity outlet is located about halfway along the Parker creek exposure. A foothill drain ditch leads to this outlet. An auxiliary outlet was installed at the point where the river dike cuts a distributary channel above the Gudbaur ranch house. The interior drainage system has not yet been completed and to date the pumping station has been operated on temporary settings. The lands have been cropped since 1931.

"The lowest land in District No. 13 is at elevation 1,749·5 feet and is located in the slough channel near the north end of the segregation. The lowest land within the 'critical area' is at elevation 1,754·8 feet and lies between observation wells 13-175 and 13-186. The bottom of the river channel has been defined (1930 survey) at six cross sections adjacent to the district and low point elevations have been found to vary from 1,699·4 to 1,715·2 feet. The average of the bottom low point elevations is 1,708·4 feet or 46·4 feet below the lowest land in the critical area. The district comprises 1,440 acres (measured on topographic maps); 1,179 acres are assessed. The elevation of the land varies from 1,749·5 to 1,770 feet; 314 acres are below the 1,756 contour inclosing lands within about 10 feet in elevation of the storage line requested.

"Ground water records are available, 1930-32, from 11 observation wells where water table elevations have been determined at intervals of two weeks. Readings during the high water season were difficult to obtain because of ponded water prior to reclamation. Since the lands were diked more frequent observations have been made during high water periods. Of these wells, 6 are in critical, and 5 are in levee areas. The observations for each group were averaged to obtain the mean for the area they represent. Individual and average hydrographs of water table for the period 1930-32 are included in Compilation of Base Data, Volume III.

"Soils in the critical area are practically all classified as peat with the usual sandy and silt loam materials recorded in the areas near the river. Several of the well logs bear the notation that the peat is coarse. Prior to 1931 the lands were used for pasture and the growth of wild hay.

"Critical areas in which water table was within 4 feet or less of the ground on April 1, 1930, comprise 680 acres. The average depth to water table at critical wells on pertinent dates follows:—

Date	Designation	Average depth to water table (feet)
April 1, 1930	Spring plowing	(0·9)
May 1, 1930	Spring planting	0·0
Nov. 1, 1930	Beginning winter	5·8
March 13, 1931	Spring recharge	2·1
April 1, 1931	Spring plowing	2·2
May 1, 1931	Spring planting	2·7
Nov. 1, 1931	Beginning winter	8·2
April 1, 1932	Spring plowing	0·9
April 7, 1932	Spring recharge	0·6
May 1, 1932	Spring planting	1·5
Nov. 1, 1932	Beginning winter	6·8

"The first full round of ground water observations in District No. 13 was made on April 2, 1930. Average depth to water table shown in the above table for April 1, 1930, is an approximation.

"It is very important to note that spring recharge occurs at a later date in this district and in District No. 10 than in neighbouring areas. The time available for improving water table conditions after recharge and before high river stages ensue is very short.

"Margins between ground surface and water table in levee area are greater than those listed for the critical area.

"The height of water table at planting time varies from year to year. Depth to water table contours drawn by L. T. Jessup correspond approximately to planting time. The areas in acres within five zones of depth follow:—

Date	Depth 0′–1′ (Acres)	Depth 1′–2′ (Acres)	Depth 2′–3′ (Acres)	Depth 3′–4′ (Acres)	Depth Over 4′ (Acres)
April 25, 1931	60	220	260	120	780
April 21, 1932	430	220	110	80	600

"From April 28 to June 1, 1930, wells in the critical area showed an average water table practically coincident with average ground surface elevation.

"Descriptions of pumping equipment, or of temporary pumps which have been used in District No. 13, are included in Compilation of Base Data, Volume IV. The quantities pumped from the drainage district during two seasons have been computed as follows:—

Year	Time in hours		Total quantity (acre-feet)
	12″ pump	8″ pump	
1931	190·1	....	125
1932	922·0	468	726

"The maximum rates of discharge computed, during the above periods, for the temporary pumps used in District No. 13 were 8·2 second-feet with the 12-inch pump operating and 2·6 second-feet with the 8-inch pump operating.

"The elevation of the bottom of the main gravity outlet is 1,748·0 feet at the point where it discharges into Kootenai River; the bottom of the auxiliary outlet is at elevation 1,746·6 feet. The maximum discharge observed passing the main outlet, 1931-32, was 4·5 second-feet."

IV

CRESTON PROJECT

On October 27, 1927, the Creston Reclamation Company, Limited, made formal application to the Commission for permission to construct certain permanent works in and adjacent to the channel of the Kootenay river at Creston, in the province of British Columbia.

This application was transmitted to the Commission by the Minister of the Interior of Canada with a request that the Commission take appropriate action.

Copies of the application and the letter of transmission were forwarded on the date of filing to the Secretary of the Commission in Washington. The application will be found in the appendix. (Appendix A.)

Kootenay Flats. In a memorandum prepared for the information of the Commission it is noted that the land proposed to be reclaimed by the Creston Reclamation Company is what is known as the Kootenay flats. The Kootenay flats is that portion of the valley of the Kootenay river lying between Bonners Ferry, Idaho, and Kootenay Landing, British Columbia, a distance of about forty-five miles in a direct line. The Creston project related to part of the flats in British Columbia. The flats average from one to four miles in width and is subject to periodic flooding. It is a typical flood plain, having river banks ten to fifteen feet higher than the land lying along the foot of the hills. The total amount of bottom land subject to overflow in the flats, before reclamation in Idaho was commenced, was approximately 65,000 acres, of which roughly 30,000 acres are in British Columbia. Of the tract in British Columbia, approximately 20,000 acres are in the control of the province, while the balance is privately held or forms portions of Indian reserves controlled by the Department of Indian Affairs of Canada. The flats are practically free from timber and brush except a narrow strip of woodland fringing the river-bank, and form a large tract of rich alluvial land lying in the heart of a mountainous region.

As noted in the chapter on Reclamation Projects, various investigations were made from time to time as to the practicability of reclaiming the Kootenay flats. These included surveys on behalf of the Province of British Columbia in 1912, of the Canadian side of the flats, and by the State of Idaho in 1915 and 1916 of the American side of the flats. Owing to the international character of any comprehensive scheme of reclamation, the local interests affected took the necessary steps to arrange for a joint investigation of the scheme as a whole by the State of Idaho and the Province of British Columbia. This was carried out in 1922, but no steps were taken to develop the scheme.

As the undertaking of the Kootenay flats project in a comprehensive manner by Idaho and British Columbia appeared remote, the farmers and settlers in the flats in Idaho organized separate drainage districts and proceeded to reclaim the Idaho part of the flats by unit or separate schemes.

Canadian Interests. As the Kootenay river is navigable, approval of the scheme under the Navigable Waters Protection Act was necessary, so far as Canada was concerned. Also portions of certain Indian reserves, amounting to approximately 1,500 acres, were included in the proposed scheme, which

entailed obtaining the consent of the Department of Indian Affairs. The consent of the Dominion was given so far as the Navigable Waters Protection Act is concerned by Order in Council dated February 4, 1928. (Appendix B.)

Indian Lands. So far as Indian interests were concerned, a letter was received by the Commission from the Deputy Superintendent General of Indian Affairs of Canada dated November 17, 1927, in which it is said:—

"Certain lands set apart for the Lower Kootenay Indians and confirmed as reserves by the Dominion Government and the Government of the Province of British Columbia have not yet been conveyed to the Dominion for the Indians. It is not improbable that some arrangement may be made to cancel these allotments and substitute for them land for the use of the Indians which will not be affected by the Creston Reclamation Company's scheme, or to otherwise compensate the Indians.

"For the information of your Commission I may state that while the Minute of the Indian Reserve Commission, when allotting these lands for the use of the Indians of the Kootenay band, expresses an opinion as follows: 'That the Commission, in dealing with the reserve lands of the Lower Kootenay Tribe or Bands, places itself upon record as of the opinion that the Government of the Dominion of Canada should contribute pro rata as guardian of the Indians concerned to the cost of any work of reclamation of valley lands at Creston or in connection with any lands which the Commission may recommend to be added to the reserve thereat,' the Commission concluded this Minute by adding, 'On the same being approved of by such Government after such expert inquiry as it may cause to be made.' Up to the present time, so far as I am aware, the Dominion Government has not directed an expert inquiry into the project."

Nelson Hearing. A public hearing was held by the Commission in the city of Nelson, British Columbia, on November 29, 1927, at which the interested parties for and against the application as well as representatives of the Canadian and United States Governments, the Governments of Idaho and British Columbia, and the Great Northern Railway, were present.

In opening the meeting the Canadian chairman, Mr. C. A. Magrath said:—

"This is the first time that the Commission has appeared west of the Rocky mountains. In the fifteen years in which it has been in operation it has held meetings on the American side all the way from Idaho to Maine and to Massachusetts, and on the Canadian side from Alberta to New Brunswick. It was brought into existence through a treaty that was entered into in 1909 between Great Britain, acting on behalf of Canada, and the United States. The Treaty was ratified in 1910. In our opinion, and in the opinion of a great many people in both countries, it has been the greatest move forward between any two neighbouring nations up to the present time. We find that in the conduct of our work the people on both sides of the boundary are always reasonable when there are questions to be discussed and determined; we find that by having those questions threshed out in the presence of both parties reasonable settlements can be effected; and I am pleased to say that in the work that we have accomplished we have always reached unanimous decisions.

"It is a great tribute to both peoples on all this international border. There is a function that the Commission is called upon under the treaty to perform of settling any questions of difference between these two peoples, those questions having first to be approved by the Senate of the United States and the Government of Canada. When you appreciate that the two neighbouring nations have gone that far, it is an evidence after all that there is some hope for the world, because so far as we can see as members of the Commission, we do not think there is any reason why other neighbouring nations might not do likewise."

Appearances. The following appearances were entered:—

Charles B. Garland of Nelson, B.C. on behalf of the Creston Reclamation Company.

T. L. Cory of Ottawa, representing the Department of the Interior of Canada, and associated with him, G. H. Whyte of Vancouver, B.C.

P. E. Doncaster of Nelson, B.C., representing the Department of Public Works of Canada.

C. G. Paulsen of Boise, Idaho, District Engineer, U.S. Geological Survey.

J. C. MacDonald, Victoria, B.C., representing the Department of Lands of British Columbia.

George N. Carter of Boise, Idaho, representing the Commissioner of Reclamation of Idaho.

R. C. Crowe, of Nelson, B.C., representing the West Kootenay Power and Light Company, Limited.

A. N. Winlaw, of Winlaw, B.C., representing the J. B. Winlaw Company.

G. A. Hunt, of Spokane, Washington, representing the Great Northern Railway Company.

Counsel for Applicant. Mr. Garland, speaking on behalf of the applicant company, dwelt upon the international phases of the case and said:—

"The lands which we propose to reclaim lie in waters which are international in that they flow from the American side to the Canadian side. They are provincial lands and are owned by the province as provincial domain, and apart from the interest of the Department of Lands in British Columbia, that department which represents and owns the public domain, there is also interested the Dominion Government in its capacity as the protector of the navigable waters. So also interested in this application is the department of the Province of British Columbia within whose jurisdiction all waters of this province are confined. Further than that, in respect of this particular application, the Department of Indian Affairs is also interested by reason of the fact that certain lands within the area proposed to be reclaimed are the lands of the Indians of this country and the wards of the department. Consequently, presuming for a moment that the lands which we propose to reclaim were withheld, say, to the north in the Great Slave lake or the Lesser Slave lake, all conflicting interests would be reconciled and the conflicting interests between all parties having any desire for the use and diversion of those waters would be governed purely and simply by the domestic tribunals of this country and by the Dominion Government departments. But by reason of the fact that these particular lands are adjacent to waters which are international in their course, this application now appears before this Commission.

"So that I have considered, and am subject to correction, that the main purpose of this Commission is in following the words of the treaty to consider the petition now before it in relation of the inhabitants of one country to the inhabitants of the other, and that the domestic issues, that is, any conflicting interests which may arise between the nationals of this country, are matters which are exclusively within the jurisdiction of the dominion and the provincial governments; that all rights and all obligations will be considered by those different departments and that elements in regard to the conflicting interests will not be a matter upon which the members of this Commission will rest their decision.

"In other words, I am fortified in my argument by the very words of the treaty wherein it is expressly reserved by the High Contracting Parties that the exclusive jurisdiction over the waters within their respective boundaries is essentially a matter for the domestic governments, and I say with respect to

that if this Commission should entertain in approaching its decision on this application the fact that conflicting interests may exist within the Dominion of Canada, it may well be that in the consideration of those conflicting interests a decision resting or based upon or supported by any grounds as conflicting interests might well interfere and override the policy of the Province of British Columbia or the Dominion of Canada, which exclusive policy or right is expressly reserved to the High Contracting Parties as between the nationals of their respective countries. . . .

"The application now before this hearing is the application of the Creston Reclamation Company to reclaim 8,600 acres of land, and I submit that this Commission will concern itself with the effect of that reclamation upon the inhabitants of the other country; that is, using the words of the treaty itself and the jurisdiction which is vested in the members of this Commission.

"With respect permit me to say that all conflicting interests within this Dominion and this province are safeguarded by the departments which are set up by the respective governments, and that it is their duty, of course, to take care of the interests of their nationals. So that, so far as any interjections may be made at this hearing of conflicting interests in Canada, may I assure the members of this Commission that the rights of all interests of all people and conflicting interests within the Dominion of Canada are safely within the hands of the departments of the province and of the Dominion vested with that authority.

"So in opening I ask that I may be permitted to present my case to you and to deal with it upon the assumption that the Commission will consider the application of the Creston Reclamation Company in so far as it affects an international aspect or an international interest, and, to use the words of the treaty itself, in so far as it involves the rights, obligations and interests of the people of the great Republic to the south, and not so far as it is affected by the conflicting interests upon these waters. That, I submit, is a domestic question within the exclusive jurisdiction of the Dominion and the province."

Reclamation Schemes. Mr. Garland pointed out that the reclamation of land in the Kootenay valley was not a new matter, and referred to the project of Mr. Baillie-Grohman in the eighties. "He became familiar" said Mr. Garland "with that great area of land lying along the Kootenay river where it enters Canada and realized how great was the wealth created by the delta which had there been formed. In or about the year 1887 he entered into an arrangement with the Provincial Government whereby it was provided that if he reclaimed these lands, some thirty thousand acres in extent in the delta district, he should receive from the province a grant of them. He proceeded upon the principle that the method under which the reclamation of these lands would be best achieved would be by removing as far as possible the cause of the high water which occurs each year by reason of the freshet in the Kootenay river at its source. He proposed to flow the high water of the Kootenay river at or near its source into the Columbia river thereby directing its course northerly and relieving the stream flowing in a southerly direction. . . .

"He at the same time contemplated taking out certain obstructions in the west arm of Kootenay lake. He proceeded with the work, took out some of the obstructions in the arm and carried out certain engineering projects at Kootenay flats. He took out some rock at the place called Grohman rapids, about 1887.... Due to financial and other vicissitudes the project of Baillie-Grohman did not succeed. He went so far but was unable to proceed farther. The vision that he had at that time of the reclamation of this land has persisted among those people who lived beside him. They have carried out the idea and during thirty years at least have taken every opportunity of directing attention to it.... The members of the Creston Board of Trade and residents of the

district have taken every opportunity, in conjunction with our friends to the south, because south of the boundary there is a delta of equal size, to direct public attention to this project. . . .

"As far as its feasibility is concerned, these men, while making their appeal for assistance and sympathy had a visible demonstration of the success of the project in the dykes which had been constructed and the crops which had been grown on reclaimed land by our friends south of the boundary and this was an added incentive to the advocates of the undertaking in their efforts to interest, to persuade and if possible to convince. These efforts extending over a period of about thirty years have culminated in the sitting of this Commission to-day.

"In regard to the fertility of the soil and in regard to the practicability of this project, I have only to say to you that, in spite of anything that might be said to the contrary, there is a visual demonstration upon the other side of the international boundary in the eighteen thousand acres of arable land reclaimed and producing crops. On one of the areas across the boundary the crops alone the first year after reclamation paid the cost of the work. In other words, the entire overhead of the reclaimed area, by the abundance of the crops grown on that land, was met and the capital outlay repaid."

Area to be Reclaimed. Asked as to the ultimate purpose of the company so far as regards the acreage to be reclaimed Mr. Garland said: "I am unable to tell you. The whole of the lands in this delta are provincial domain. Some years ago, in 1922 or 1923 to be exact, a deputation waited upon the Minister of Lands of the Province of British Columbia. He, complimenting us upon our strength of purpose over so many years, eventually said: 'If you will reclaim 10,000 acres the province will give you a Crown grant when that has been done'. As far as the company is concerned, it has now the right to reclaim 10,000 acres and that having been done successfully a crown grant will be issued to it. . . . As to the future disposal by the Department (of Lands) of these lands I have no information or knowledge, but we have no right to expect anything from the Provincial Government other than the 10,000 acres which are now promised to us."

Capitalization. Asked as to the capitalization of his company he said that it was $50,000, of which $4,500 had been subscribed, and that in view of the success with reclamation of lands on the Idaho side and the character of the crops raised on them, the company did not expect to have any difficulty in obtaining all the capital it would need.

To the suggestion that the project seemed to have the character of a stock-selling proposition, Mr. Garland said:—

"If I may be permitted, I do not know that there is anything further from the minds of the directors of this company than that this should be a stock-selling proposition, or that it should be financed in that way. Permit me to say this: I have lived in this district close to these lands and for many years have been associated with these gentlemen in this matter. The district adjacent to these lands is composed of bench lands upon which there are a very considerable number of settlers who have come there over a period of many years. Those settlers who came in at that time bought land upon the bench lands above these flats at various amounts, possibly from $50 up to $100 an acre. To reclaim that bench land and make it fit for agriculture and arable it cost those settlers in that district at least $200 an acre, and that land is fruitful and bears crops now. In the case of the bench lands of this country, due to the fact that they are timbered, and also to other conditions, far from the first cost being the last cost, after the farmer purchases his farm land at a certain value, he must, on top of the purchase price, place the cost of fitting his land for cultivation. Many years of hard work, much trouble and the expenditure of a good deal of

money stand between him and the productiveness of the farm he has bought. He will have to expend perhaps $150 per acre and in some cases $250 in order to make his land fit for the plough. This delta land at this time is fit for the plough. It can be reclaimed from the inundation of the Kootenay river at an approximate cost of $50 per acre. Now, I say to you that land in this country, which on the one hand costs the settler somewhere in the neighbourhood of $300 per acre before he can place his plough upon it, is unproductive compared with land which can be made fit for the plough at a cost of $50 per acre."

Asked as to how the company expected to raise funds so as to enter into contracts for the prosecution of the work, Mr. Garland said that he was instructed that the directors had been in touch with men well able in themselves to carry through the reclamation of the land and well able to finance it, so that there would be no difficulty in that regard. These parties were British Columbians and financial men on the United States side of the line. He represented the ideas of a great many men who desired to see this land reclaimed.

Mr. Commissioner Clark said: "We all want to see the land reclaimed but before tying up the country on either side of the line in any proposition of this kind I think it should be looked into carefully so as to make sure the purpose will be achieved and that the land in these districts will not be tied up for a number of years by a company which is trying to do its best but which is unable to produce the results desired."

Mr. Garland repeated that the company was relying upon the experience in the Idaho Drainage Districts; and Mr. Clark commented, "Not any too satisfactory. It has been a pretty hard pull to get these lands into the condition they are in now. It has not been all beer and skittles in regard to the reclamation of this land. They have achieved a wonderful success but it has been through years of trouble and disappointment, at times followed by years full of promise and accomplishment. It has not been done without hard work."

Mr. Garland replied: "Neither has ours. Side by side with these people, we have suffered as they have suffered, and we have hoped as they have hoped."

Acreage Involved. Mr. McCumber asked if his impression was correct that there was a little over 30,000 acres on each side of the line that could be reclaimed, one part perhaps just as easily as the other, and all the same kind of land; and Mr. Garland replied, "Yes, sir."

"Then," said Mr. McCumber, "my next impression would be that whatever is done ought to be done so that there will be harmonious action between both sections and looking ultimately to the opening up of every acre of these 30,000 acres on each side. . . . Will other companies speak for the balance of that 30,000 acres or does your company expect when you develop this first unit to reach out and take care of the remainder of the 30,000 acres in a similar manner, or will there be other companies organized to take over other sections?"

Mr. Garland replied: "On the American side of the line the whole of the land, amounting to some 31,000 acres were owned by private individuals. On our side of the line the whole of the land was owned by the Provincial Government. In other words, any scheme of reclamation would have been a government undertaking but the time was not ripe and the proposition was not looked upon kindly as a government scheme. Then, matters of policy and other considerations entered into the decision no doubt. The whole of the 31,000 acres was Provincial Government land and could not be reclaimed by anyone. No one could utilize that land without the consent of the Government. The Government did not desire to enter into it in its capacity as a public reclamation scheme but having regard to the length of time, the work and expense that the supporters of this drainage proposal have contributed to it, the Government said: 'To you who have given this time, who have held the light aloft, we will give 10,000 acres if you will reclaim the land.' That is the first and last of it, sir."

Sir William Hearst said: "Is it not in this position, that up to the present the Provincial Government have said, 'If you reclaim your 10,000 acres we will give you the title to this 10,000 acres,' simply holding back until they see whether you are able to accomplish the reclamation of that 10,000 acres before committing themselves any further?" Mr. Garland replied, "That is it."

"Consequently" said Sir William Hearst, "you are not in a position to say what will be done when you reclaim your ten thousand acres, because the Government have not told you what they will do."

Mr. Garland replied, "Exactly. Should we reclaim this land thereby creating a new value, any decision that may be taken about that by the Provincial Government will be based upon an altogether different situation as compared with that existing at the present time. We would have borne the burden of the battle and shown that this land has a value and can be reclaimed. We would have further arguments or rights should we desire to make overtures which is not our intention at the present time. The Government would then probably have to deal with different conditions as compared with those existing at the present time."

Company's Title. To a question as to the nature of the company's title, Mr. Garland replied that it was a private title, but would not be effective until they had reclaimed the land, and he added, "So that between us and the title is the approval of this Commission and the erection of our works." He added that the title would be conditional upon the raising of the dikes and that they must also survive one high water.

Andrew McCulloch. Mr. Andrew McCulloch, an engineer residing in Nelson, said that he had been thirty years in the district and had done a good deal of work on most of the streams in the Kootenay country. He had made a special study of the conditions of stream flow. He was a consulting engineer and had been engaged by the Creston Company to prepare its plans.

Describing the physical situation in connection with the company's application he said: "The banks of the river extend to an elevation on our north boundary of 1,760 feet, at our south boundary of 1,763 feet, being about 20 to 23 feet above the level of water in low water stage. In round figures the elevation of the land that is proposed to be reclaimed would be 1,750 feet, a great deal of the areas at an elevation of 1,750 feet being 10 feet above the low water in the river and from 10 to 13 feet lower than the banks of the river.

"Eighteen ninety-four was the highest known high water on the Pacific coast or in the Kootenay river. Such high water has not been known within the memory of the oldest inhabitants, dating back, well, possibly not authentic in the earlier years, but at least 50 years. Since 1847 the records have been kept at the Dalles on the Columbia river. There is no attempt on the part of the Idaho people or any other reclamation interests to guard against the 1894 flood level. At Nelson that 1894 level was 7 feet higher than the 1916 level. So there is no attempt to guard against the flood of 1894. But it is our intention to guard against every other known flood elevation. Nineteen sixteen is what we have based our calculations on.

"To reclaim this land we propose to construct a levee or dike along the river bank to an elevation of 1,769 feet; 29 feet above the low water level of the river. Across the north end we will have a dike from the river bank over to the high ground at the same elevation. Running through the land that we propose to reclaim there is a stream called the Goat river. The Goat river must be diverted from these lands to reclaim them. We propose to divert the Goat river. The Goat river comes in from the hills on the east side and flows right down through the centre of all this land."

He said that the diversion of the Goat river was the first essential in reclaiming the land. Then they would have to build the dikes to an elevation of five feet above the level of the 1916 flood. That he believed would amply protect against any possible overtopping of the dikes. They would also build drains to keep the land fit for cultivation and would provide pumps to carry off the rainfall and seepage. Probably crude oil or gasoline would be used for the pumping. The top of the dike would be 16 feet in width and the slope would vary in accordance with the height of the dike, 3 to 2 and 2 to 1 at the highest dike, while on the river bank where the elevation is not so great, it would perhaps be 2 to 1 and 1½ to 1. The dikes would be ordinary earth fill, dredged material.

A question having been raised as to the suitability of this material to resist erosion, Mr. McCulloch replied: " The records show that only in one year out of three does the water ever reach the top of the banks of the river. There might be openings in spots, or little depressions, where some water escapes, but taking the general level of the banks, only once in three years does the water reach the bank elevation, so that there is not much elevation above the banks that we have to provide against."

Asked the cost per acre of the improvement, he replied: " We figure that it will probably cost $50 per acre. The cost in Idaho has varied from $26 to $58 ". That would amount to about $400,000.

Mr. McCumber raised the point that because of the rapid cutting down of forests, the danger of overflow would increase. Mr. McCulloch said:—

" There is a general opinion that deforestation seriously affects high water conditions. That effect is dependent on the character of the country. In a low-lying country the whole of the snow goes off quickly. In the mountains the general run of the country has very high elevations, 5,000 feet and higher. It does not apply here in the same way as it does in the more low-lying regions and it is only to a very limited extent that the denudation of the forest due to logging operations affects our high water in the Kootenay river. The first rise we get is the result of snow melting on low-lying land. That is all over and the rivers recede somewhat before the water comes from the higher elevation. Therefore I am not prepared to admit that on the Kootenay river the denudation of the forest is going to increase the flood conditions. It may be that forest fires in the hills, mostly caused by lightning, would have some effect upon it, but I am not prepared to admit that the Kootenay river will be affected."

Mr. McCulloch did not believe that the proposed diking, being confined to a portion of the bank on one side of the river, would have any serious effect on the height of water south of the boundary. If eventually lands on the other side of the river were also diked, there might be a possible effect. He believed that he was right in stating that Idaho interests were not objecting to the present project as they felt that it would not affect them.

In answer to a question Mr. McCulloch said that the distance from the south limit of their lands to the boundary would be about six miles.

George N. Carter. Mr. George N. Carter testified as to the effect of diking in British Columbia upon interests in Idaho. He said: " It just occurred to me that I might be able to help you a little in your line of reasoning by suggesting that if we take a hypothetical case and assume that both sides of the river bank are diked, the increase in flood stage would be three feet. If you built a dike on one side, that would not increase it a foot and a half. It is an increasing function as your channel narrows down. As to what it is in this particular case, I am not prepared to say. I doubt if anybody else is. Somebody could very likely make an intelligent estimate or forecast. . . .

" It requires considerable investigation and very careful study in order to make intelligent answers to these problems before these conclusions can be reached and we feel that we would have to have considerably more information

in order to make an estimate. The more time we have and the more money that is spent on investigations in the field, as well as office work and analyses and conclusions that may be drawn, the safer we will all be in any intelligent conclusions that we arrive at. . . .

"Primarily there should be a good deal of work done in measurement of the water, the flow of the streams. In addition to that, there should be slope studies made of the river, getting the gradient of the bed, under present conditions and as it may be affected by further diking. In addition to that it might still be necessary to do some surveying or topographical work in order to get more thorough and complete data on the actual cross-section of the stream channel as it is now and as it may be after more of the valley is diked.

"I think we would then be in a position to give intelligent answers to some of these things that we are now compelled to more or less guess at. We have been guessing at them for several years, and I suppose we will have to guess a little longer unless we get some intelligent information to base figures on."

Questioned as to investigations on behalf of the United States Government, Mr. Carter said: "In 1916 and 1917 the United States Department of Agriculture made a preliminary investigation and report on this Kootenay valley reclamation in Idaho. It was a very comprehensive report and the more I study it the more respect I have for the value of it; but there are some things in there that necessarily must be forecasted and projected ahead; they could not hope to hit it all the time, but generally speaking that is a very constructive and full report. That is the only cognizance taken of the Kootenay project by the Federal Government so far as I know."

Mr. McCumber asked the question "In the reclamation of lands in Idaho you are secure against any flood that is not bigger than that of 1916, are you?"

Mr. Carter replied. "I am not positive that we are."

Mr. McCumber. "In fact you look for floods every three or four years that may possibly destroy your crops, do you not?"

Mr. Carter. "Yes, it is a possibility but not likely as often as once in three or four years. . . . Conditions vary with the various units. There are some units in Idaho that we think are secure against any flood, because those dikes have been constructed higher than any flood that has been forecast. Another method is to construct a lower dike at a considerably cheaper cost with the expectation of being flooded one year out of five. A district has recently been finished on that basis."

Asked by the chairman as to the effect of diking upon Idaho interests, Mr. Carter said: "My study of the present conditions this year (1927) leads me quite firmly to the conclusion that there is an effect from the diking of the channel but the extent of that effect I do not pretend to know. I have not figured it out, I have not spent enough time on it, and possibly I could not discover it if I spent the rest of my life on it, but I am satisfied that there is an effect. I know that water flowing in the Kootenay river reached a higher elevation in May this year than it would have had there been no dikes in the lower valley.

The Chairman said, "You heard the statement of the engineer of the company, Mr. McCulloch, that he did not believe there was any opposition on your side to this application. Are you prepared to make any statement as to that?" Mr. Carter replied, "So far as I am aware there is no opposition; no protest has been filed."

In reply to a question as to the relative efficiency of different types of dikes, Mr. Carter said: "We have attempted to make dikes such as come within the limits of cost feasibility. It has been to a certain extent a matter of choice with the individual districts. One district would prefer to build a dike to protect them against any floods. Other districts prefer to spend money with the expectation of being flooded some years. It is a matter of mathematics and finance."

J. P. Vernon. Mr. J. P. Vernon, engineer, of Bonners Ferry, who had been engaged in reclamation work in Idaho, gave his opinion as to the effect of the proposed works at Creston on interests in Idaho. "Generally speaking" he said, "from such information as I have acquired or gathered in two years of reclamation work over there, I do not see how the diking of one side of the river will materially affect us on the other side of the boundary. Now, our dikes have been built; we have what we call partial reclamation and we have also what we claim to be complete reclamation. Mr. Carter told you about the partial reclamation this morning. He is very well acquainted with the data because it is his department that has been passing upon the certification of our bond issues and it makes a very thorough investigation of the district before it issues these certifications. That, however, applies only to diking operations in the United States.

"Something was said about the character of the soil being such that the current would tend to wash it away or destroy the dikes. I have gone through two high water periods, that of 1925 and that of 1927, and I have not found at any time that the diking material was washed away or the work injured or destroyed. It is seepage that affects us more than anything. These are things that we hope with time and investigation to be able to overcome.

Replying to a question as to the total acreage reclaimed in Idaho, Mr. Vernon said: "I presume 10,000 or 12,000 acres. About 30,000 acres will likely be reclaimed. Some statements have been made to the effect that there will be 35,000 acres of reclaimed land in the United States. That would be true if every nook could be diked but in some instances it would be too costly at this time to reclaim the land. It may be a small lake and when the demand is such as to justify the reclamation of land of that character it will be reclaimed. It is the richest kind of land. The analysis you find in the Jones and Ramser report shows it to be the richest soil of its kind in the United States. The production is anywhere from 40 to 70 bushels of wheat to the acre this year. Senator Borah was helping to thresh down on the Doctor Currie farm in District No. 8. He was pitching wheat and it was found that the yield was 48 bushels to the acre.

"In District No. 1, which was reclaimed during 1922, the average yield in 1925 after three years' cultivation was 110 bushels per acre. It gives you an idea of the value of the land for the production of certain crops. There was one farmer who last year produced 100 bushels of peas per acre."

C. B. Garland. Mr. Garland referring again to the meeting between the Minister of Lands of British Columbia and the Creston Board of Trade, filed with the Commission copies of letters from the Minister of Lands in 1925, 1926 and 1927, confirming the promised grant of 10,000 acres and extending the time for reclamation from year to year.

Discussing the character of the Creston Company, Mr. Garland said:—

"With regard to the formation of a company rather than in the manner of a syndicate in which it was previously formed, this is purely a number of men living in sparsely settled districts who from time to time have dug out of their pockets money for various reasons, mostly for advertisement and propaganda; and after we had this letter offering us something, after the areas in Idaho had been reclaimed, and we had demonstrated that this thing was possible, we were able to get a little more assistance from our neighbours and a company was formed, that being the better way in which to carry on the business. So that the money is there now."

"So far as the commercial end of it is concerned, the public or any one else is entirely protected by reason of the fact that the province is in a position at any time to withdraw from us all we have done over 30 years, and all the money we have expended will be lost. So I trust there is merit in the application."

A. N. Winlaw. Mr. A. N. Winlaw testified as to the effect of the proposed reclamation on their saw-mill industry on Goat river.

B.C. Department of Lands. Mr. J. C. MacDonald of the British Columbia Department of Lands confirmed the statement that the land was granted conditionally and that the provincial Government is entirely sympathetic to the undertaking.

R. C. Crowe. Mr. R. C. Crowe, set forth the interests of the West Kootenay Power and Light Company and the effect thereon of the proposed reclamation scheme at Creston. Mr. Crowe said: "These various schemes of reclamation are depriving the river of its reservoir. Every acre that is reclaimed, in the manner in which it is being reclaimed here, will deprive the river of its natural reservoirs to that extent. The 30,000 acres reclaimed in Idaho have deprived the river of its natural reservoirs with the result that at the time of freshets the water goes down the river quickly; instead of flooding the land and staying there for several months, it passes off in a week or two. We have found in recent years from actual gauge readings that there is a difference approaching 2 feet of extra flood crest that we would have to contend with at the plant which had not been found in the flood figures of previous years. The conditions to which I have referred are responsible for this difference in the flood crest. They are likewise causing the low water period. If the water passes off quickly instead of being stored up in these reservoirs we have a low water period in winter. That is upsetting our calculations. We require 10,000 cubic feet per second above the falls to develop this power.

Sir William Hearst: To develop your present volume?

Mr. Crowe: At No. 2 plant we must have 10,000 cubic feet per second and also at No. 1. With the extra unit and the new plant we are now building we will require 10,000 cubic feet per second. We used to get that but now we do not get it except under the more favourable conditions which we have been experiencing this winter. Therefore, we have to do something to protect ourselves by conserving the water, and our proposal, which will finally have to come before this Commission, is to build a dam at the foot of this lake so as to conserve the water during the low water period. We will have to regulate that dam naturally or control the river so that we can dispose of the flood water. It will have to be done to the satisfaction of this Commission and of the engineers concerned. But it has to be done and that is the only way we can feel sure we are going to have enough water to run these plants in winter time.

"There will have to be done also certain work in the river. Our dam will be so constructed as to dispose of much more water at the flood crest than the river will let go at the present time. That is all going to be beneficial to these people for their reclamation up above and they are going to need it more and more as they reclaim land farther down. The engineer has told you that having increased their flood level in the upper districts about 2 feet, the more land they reclaim down below the more they are going to increase the flood crest. They will have to get somebody to clean out this lake so that the water can get away quicker. They have done nothing to the lake below to let the water get out. Our proposal is to clean out the mouth of the lake and build a dam to conserve low water there. We will increase the height of the (low) water but we will dispose of the flood crest quicker. If we build a dam to conserve the water to a point, say, some 6 feet above low water mark in the lake, then we back that water up across the boundary line. We are being forced to do that because of the Idaho reclamation and the present application and therefore we are being forced into an international issue in consequence of this work we are now considering but more particularly in consequence of the Idaho development and also in consequence of the depletion of the forests. We are not objecting to anybody

reclaiming land. On the contrary, we are glad to see them get a chance to reclaim it. But they are putting us in a position where we will have to do something to conserve the water supply at the low water period and that brings us to an international issue that you will have to consider. We require a great deal more detail and engineering work to be done before we can present our application to you and that is why the matter has not been submitted to you to-day; but we are proceeding with that work and we will hasten it forward and place it before this international body as soon as possible. It seems to me that all these things work hand in hand and should come together. Of course, Idaho having done this work, or most of it, our only redress now would be in the United States courts. Under the treaty we have a right to go into the United States courts for any remedy in Idaho. We cannot complain of it to this Commission. We assume of course that 8,000 acres would not make any material difference but if all the works are carried out and if the 30,000 acres here are added to Idaho's 30,000 acres it will make a material difference and as we believe a very material difference. We want it to be understood that we are not objecting to this application but we also want to let you know that these things impose upon us a problem which will bring us before this body at some time or other. The situation brings us into conflict with the state of Idaho because of the backing up of the water.

"Mr. Powell: What do you want done?

"Mr. Crowe: We want permission to store 6 feet of water at low water mark. We want to have in all areas exactly what they have in the United States to-day. Owing to the extra moisture resulting from wet weather we have storage in the lake now up to 5·7 feet and I think anybody here will tell you that they are not affected or exposed to damage in the state of Idaho by that condition; their sluice gates are above that level to-day and when we construct this dam and store this water they will still be above the level and have drainage. We realize that we cannot have storage to make drainage impossible. We will have to get permission for the passing of some 6 feet of water through Kootenay lake and we will have to get it from this body because it runs right back to the boundary line and the level will be raised 2 or 3 feet.

"Mr. Powell: Assuming we grant the present application, do you think that will interfere with you in another application you may make?

"Mr. Crowe: No, except that if it is a matter between the United States and this country we were wondering how far you would be bound. Of course, I do not think this application interferes with ours but I think this is the proper occasion to let you know that we are very much interested in this matter because we are going to have an application of our own. We do not want to oppose this application."

Lorne A. Campbell. Lorne A. Campbell testified as to the relationship between the reclamation projects and the development of water power on the Kootenay. He said: "I might say that in 1911 there was a reclamation scheme figured out to reclaim the lands in the vicinity of Creston. That was intended to be brought about by opening up the river at Granite 5 miles from here. Our gauge readings show that that is the point that restricts and holds back the high water. In other words, it was necessary for the lake to reach an elevation of 12 feet before the channel area is opened up sufficiently to take care of the high water that is coming in, and by that time the weather is such that it keeps piling up. That is what creates high water, in my opinion, in Kootenay lake.

"Now, as I said, we propose to open up the channel at Granite and construct a dam there which will pass 200,000 second feet. To get the water to that dam it is necessary that we dredge out at the mouth of Grohman creek about 2½ miles from here down the Kootenay river. Then, in order that the reclama-

tion company in Creston would be benefited by our dam it would be necessary to dredge out the narrows at Proctor. That, of course, would be worked out either between the Creston people, the Dominion Government and ourselves.

"I might state further that we have been on this river for 30 years. We have been studying the conditions continually. The elevations that we have constructed are No. 1 Plant at Lower Bonnington, No. 2 Plant at Upper Bonnington and No. 3 Plant at South Slocan. They are such that, with the reclamation of the land that is already reclaimed in the vicinity of Bonners Ferry, when 30,000 acres will be reclaimed in the vicinity of Creston, it then means that it is going to impose an entirely new condition on our existing work. Based on 1916 high water it means that it will raise the lake from 4 to 5 feet higher than the 1916 floods. Therefore, it is a question to be worked out, in my opinion, with the Creston people. And in working out this scheme it is going to be of enormous benefit to the land already reclaimed in the vicinity of Bonners Ferry. It is just a question of then regulating the get-away. In other words, we are going to open up the river below so we can take care of the high water as fast as it comes in. Then it is only a question of the Creston people getting together with us and working out some scheme to open up Proctor narrows and increase the area there. By so doing the Idaho people may derive the benefit of our work. It will only be a question of arranging the opening of the sluice gates to increase the velocity of the water in Kootenay river up to the point that the banks will stand it, and I consider that our scheme will be a great benefit to both Idaho and the Creston Reclamation Company.

Public Works Department of Canada. Mr. P. E. Doncaster explained the interest of the Department of Public Works of Canada in the reclamation project in connection with the administration of what is known as the Navigable Waters Protection Act. Kootenay lake and river from the international boundary to the confluence of the river with the Columbia at Castlegar were regarded as navigable waters within the meaning of that Act. The department then had the plans of the Creston Company before it for approval. It may be noted that that approval was covered by Order in Council. (See Appendix B.) Mr. Doncaster also filed a list of twenty-seven public wharves of a total value of $200,000 built and maintained on Kootenay lake by the Department of Public Works; also a list of seven of the more important private wharves.

United States Requests More Time. At the close of the hearing the United States Chairman announced that the Commission had received a letter from the Secretary of State for the United States requesting a period of one year to enable the Government to obtain technical data as to the probable effect of the proposed reclamation works on interests in the United States. This letter was supported by a communication from Charles M. Barnes, Counsel for the Government of the United States. Both these documents will be found in Appendix C.

Order for Adjournment. The Commission having gone into executive session, resumed public session and announced its decision on the request of the United States Government as follows:—

"A letter from the Secretary of State for the United States requesting that proceedings on the application subsequent to this hearing be postponed for a period of one year to afford time for the collection and study of the necessary hydrographic and topographic data was presented to the Commission and also a written argument by Charles M. Barnes, Counsel for the Government of the United States, in support of such application for postponement. After full consideration of said application and the argument of counsel in support of the same it was ordered:

"That this hearing do stand adjourned to be resumed at such time and place as the Chairmen of the Commission may fix and that in the meantime a copy of the record of to-day's proceedings be furnished to the Secretary of State for the United States with a view of affording opportunity for the representations or statements in view of the facts disclosed by said record, if any, that the Secretary of State may see fit to make."

Washington Hearing. The Commission held a public session in the city of Washington on April 3, 1928, at which Mr. J. A. Metzger, Counsel for the United States Government, made the following statement:—

"After studying the records of the proceedings had at Nelson and after conferring with the engineers of the Government who consulted the reclamation authorities of the State of Idaho, it was concluded that the Government would be warranted in stating that it had no objection to the issuance of an order permitting the construction and operation which are entailed in this reclamation project; but that the order should be so worded that they could not proceed with more extensive operations which might have an effect on the United States side of the line without opportunity of making study and investigation by our engineers. It is not clear that the application is limited to Unit No. 1; there has been some doubt about it; it does not define the scope."

The Commission thereupon issued the following order:—

INTERNATIONAL JOINT COMMISSION

IN THE MATTER *of the Application of the Creston Reclamation Company, Limited, for Permission to Construct Certain Permanent Works in and Adjacent to the Channel of the Kootenay River in the Province of British Columbia at Creston.*

ORDER

WHEREAS, the Kootenay river is a river flowing across the boundary between Canada and the United States within the meaning of Article IV of the Treaty between the United States and Great Britain dated the 11th day of January, 1909; and

WHEREAS, the Creston Reclamation Company, Limited, has presented to and filed with the Commission plans and specifications for the construction of permanent works for the reclamation of certain lands adjacent to the channel of the said Kootenay river, near Creston in the province of British Columbia, namely:—

1. The construction of a levee or dike around the area shown on plan of Unit No. 1 of the reclamation of the Kootenay river flats, said levee to be constructed to elevation 1769·0 of the dimensions shown on plans and specifications.

2. The diversion of Goat river into the Kootenay river on section 4, township 8, in accordance with said plans and specifications.

3. The construction within the area reclaimed of the necessary drainage ditches to satisfactorily drain said area.

4. The installation of a four-foot concrete drainage pipe through the levee, with suitable iron sluiceway valve or flap valve on the river end of same, both ends of the drainage pipe to be protected by satisfactory concrete retaining walls.

5. The installation of the necessary centrifugal pumps and engines on concrete foundations in a suitable building, with the necessary suction and discharge pipes and accessories thereof; and

WHEREAS, said application came on for hearing at the city of Nelson in the province of British Columbia on the 29th day of November, 1927, after due notice to all parties interested in both countries of the filing of said application and of the time and place of said hearing, when evidence was adduced and all parties so desiring were heard; and

WHEREAS, at said hearing a letter was read from the Secretary of State for the United States requesting that proceedings on the application subsequent to said hearing be postponed for a period of one year, to afford time for the collection and study of the necessary hydrographic and topographic data; and

WHEREAS, upon the matter coming on this day for further consideration, counsel for the United States appeared and withdrew all opposition to the matter being now disposed of in so far as it affected said Project No. 1, and consented on behalf of the United States to an order now being made with respect to said Project No. 1 as asked by the applicant; and

WHEREAS, the members of this Commission, after having read said application and specifications and perused said plans, and having heard the evidence adduced and what was alleged by all parties appearing before them as aforesaid, determined that the said works should be approved and authority given for the construction thereof pursuant to said Treaty, subject to the conditions hereinafter set forth.

THIS COMMISSION THEREFORE ORDERS AND DIRECTS:

1. That the said plans and specifications be and the same are hereby approved, and the construction of works in accordance therewith authorized under the provisions of said Treaty, upon and subject to the following conditions:—

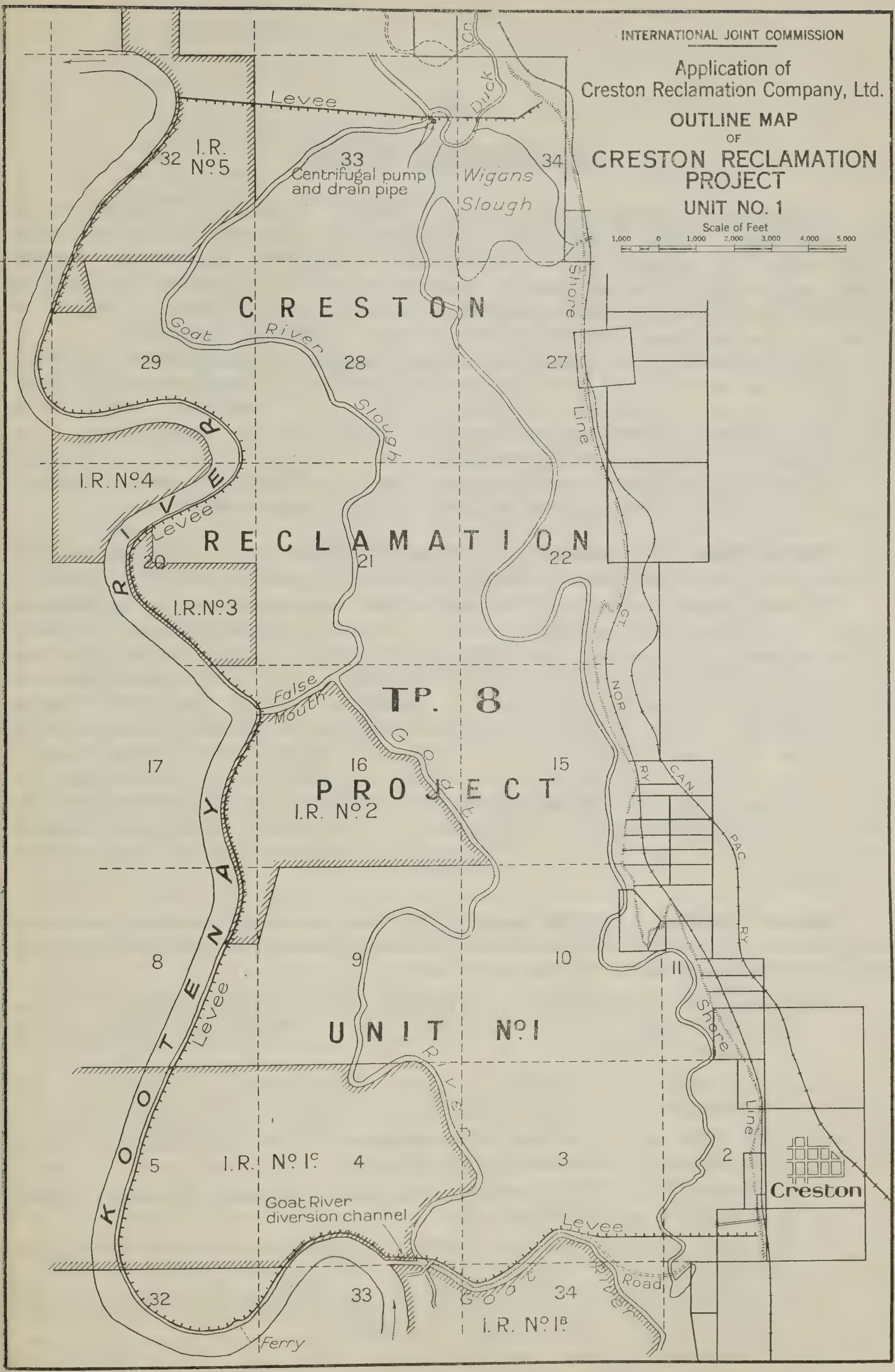
2. That the said applicant make suitable and adequate provisions to the satisfaction of this Commission for the protection and indemnity against injury by reason of such works of all interests on either side of the boundary.

3. That this Commission doth hereby reserve to the applicant and to all parties having claims for injuries in respect of said works, the right to apply for such further order, direction or action with reference to such claims as may seem proper.

4. And this Commission doth further order and declare that nothing in this order contained, in the recital or elsewhere, shall by implication or otherwise be construed as an adjudication upon the right of the applicant to construct reclamation works other than those particularly shown and mentioned in said plans and specifications in connection with Project No. 1, nor be considered as a precedent in any way in connection with projects other than said Project No. 1.

Dated at Washington, D.C., this 3rd day of April, A.D. 1928.

C. D. CLARK.
C. A. MAGRATH.
FRED T. DUBOIS.
W. H. HEARST.
P. J. MCCUMBER
H. A. POWELL.


INTERNATIONAL JOINT COMMISSION
Application of
Creston Reclamation Company, Ltd.
OUTLINE MAP
OF
CRESTON RECLAMATION
PROJECT
UNIT NO. 1
Scale of Feet
1,000 0 1,000 2,000 3,000 4,000 5,000
CRESTON
RECLAMATION
PROJECT
UNIT No.1
Tp. 8
Levee
Centrifugal pump
and drain pipe
Wigans
Slough
Duck Cr.
Goat River
Slough
Shore Line
GT. NOR RY
CAN. PAC. RY
I.R. No.5
I.R. No.4
I.R. No.3
I.R. No.2
I.R. No.1c
I.R. No.1B
False Mouth
KOOTENAY RIVER
Goat River diversion channel
Road
Ferry
Creston

V

KOOTENAY FARM

In September, 1932, George Leonard Salter, Trustee in Bankruptcy of the Kootenay Valley Power and Development Company, Limited, made application for permission to rehabilitate, reconstruct and repair certain permanent works in and adjacent to the channel of the Kootenay river and to construct and maintain certain permanent works in and adjacent to Boundary Creek in the Kootenay District of the province of British Columbia.

This application was transmitted to the Commission on September 30, 1932, by the Under Secretary of State for External Affairs of Canada, with a request on behalf of the Canadian Government that the Commission would take whatever action seemed appropriate with regard to the application. The application will be found in Appendix E.

In October, 1932, the West Kootenay Power and Light Company, Limited, filed a Statement in Response to the Application. (Appendix F.).

Public Works of Canada. In December, 1932, the Commission received a letter from the Department of Public Works of Canada in which it is said:—

"After a careful survey of the matter it is reported that this application refers to a scheme being essentially a reconstruction and repair proposal covering dykes originally commenced about 1892, and that the usual procedure in matters of this kind where navigable waters are affected is, first to deal with them as an application for approval under the provisions of the Navigable Waters Protection Act. If the applicants can show that all the works referred to were built prior to June 1, 1918, or were in process of construction on that date, it would be possible to approve such works, covering at the same time the reconstruction and repairing now proposed, provided it is found that they do not constitute an unreasonable obstruction to navigation. This would dispose of the approval of the works from the domestic point of view by the Canadian authorities."

Nelson Hearing. A public hearing was held in connection with the above application in the city of Nelson, British Columbia, on August 26, 1933, at which the following appearances were entered:—

Sherwood Lett, representing the applicant, George Leonard Salter, Trustee in Bankruptcy of the Kootenay Valley Power and Development Company, Limited.

J. A. Metzger, Department of State, Washington, representing the Government of the United States.

John E. Read, Legal Adviser, Department of External Affairs, Ottawa, representing the Government of Canada.

R. C. Crowe, Trail, B.C., Counsel, representing the West Kootenay Power and Light Company, Limited.

G. E. Clark, District Counsel for the United States Indian Irrigation Service.

J. T. Johnston, Ottawa, representing the Department of the Interior and Department of Indian Affairs of Canada.

A. J. Matheson, Ottawa, representing the Dominion Water Power and Hydrometric Bureau.

T. M. Patterson, Ottawa, representing the Dominion Water Power and Hydrometric Bureau.

C. E. Webb, Vancouver, District Engineer, Dominion Water Power and Hydrometric Bureau.

A. C. Whitehouse, Vancouver, Hydraulic Engineer, Dominion Water Power and Hydometic Bureau.

J. C. MacDonald, Victoria, Comptroller of Water Rights, representing the Government of British Columbia.

E. H. Tredcroft, Hydraulic Engineer, representing George Leonard Salter, Trustee in Bankruptcy of the Kootenay Valley Power and Development Company, Limited.

A. L. McCulloch, Creston, B.C., representing the Creston Reclamation Company, Limited.

R. W. Davenport, Washington, D.C., Hydraulic Engineer, representing the United States Geological Survey.

R. C. Crowe. At the outset Mr. Crowe said on behalf of the West Kootenay Power and Light Company that the company had decided to withdraw its protest against the granting of the application as embodied in the Statement in Response. Mr. Crowe said: "I will request, however, that there be put upon record merely this statement, that we say that if the Reclamation Farm project is allowed, the level of Kootenay lake will be increased 0·30 feet based on the 1916 flood conditions, and that therefore this is one more reason why something should be done at some time and in some way to decrease the flood levels of this lake."

Sherwood Lett. Mr. Lett on behalf of the applicants said: "The applicant, Mr. G. L. Salter, is Trustee in Bankruptcy of the Kootenay Valley Power and Development Company, Limited, a company which was incorporated in British Columbia under the laws of that province. Lot 774, the area proposed to be reclaimed, is located in the southern portion of British Columbia, in the Kootenay District, immediately adjacent to the international boundary. The southern part of Lot 774 is the international boundary as determined by the Boundary Treaty. Directly opposite is the land of Mr. A. Klockmann, in Idaho. The Reclamation Farm, as Lot 774 is known, is actually owned by the Alberta and British Columbia Exploration Company, Limited, which is a British Corporation incorporated in England and duly licensed to carry on business in British Columbia. The trustee—and I will explain later how the trustee happens to be making this application—proposes to carry out the rehabilitation primarily of certain works which have existed for a very long time and certainly for the most part existed prior to the entering into of this Treaty under which the Commission is established by the respective countries."

Mr. Lett then filed plans showing the dykes as they now exist on the applicant's property as well as those portions of the dykes that had been carried away and that it is now proposed to rehabilitate. He emphasized the fact that the application was primarily for rehabilitation purposes, the new dike construction being for the portion along the southern boundary.

"There is," he continued, "a creek flowing along our southern boundary at Lot 774 known as Boundary creek. At a point just below the foothills, Boundary creek flows precisely along the international boundary, as marked by monuments 206 and 207 on the ground. The reason for that is that at one time when the dyke was constructed along our southerly boundary the earth was taken from outside the dyke and thrown back. That left what has been described here in another hearing as a borrow pit, which in that case happened to be on the south side of the dyke.

"At some time, which is not clear in the record, Boundary creek broke through from its normal natural course into that borrow pit which ran directly along the international boundary, and Boundary creek formed its own course which is an artificial course, and that is the course in which Boundary creek now runs. In other words, it is a real Boundary creek. It runs along the boundary from a certain point to a point near its confluence with the Kootenay river where it flows off again to the south to the lands of Mr. Klockmann."

History of Project. After explaining the status of the Trustee in Bankruptcy, and filing various exhibits, Mr. Lett went on to say:—

"I will deal briefly with the history of this project, as I think it would probably be worth the time expended in doing so, as this will probably differentiate it from many applications which may at some future time be received in respect to lands in Canada on this side of the international boundary. The history of the project is set out in some detail in the application itself, paragraphs 3 to 16 inclusive, pages 4 to 6. I do not propose to read all of this, but I do want to read one or two of the high lights, so as to give you an idea of how the project came to be in the position it is in now.

"On or about the 26th day of September, 1891, The Alberta and British Columbia Exploration Company, Limited (hereafter called the British Company) a company incorporated under the laws of England, entered into an arrangement with His Majesty the King as represented by the Government of the Province of British Columbia to reclaim certain lands, being a part of the lands known as Kootenay flats.

"The original of that agreement has been lost or destroyed. We have never been able to locate a copy. Recently we found a copy unexecuted but apparently a copy of an executed original in the Department of Lands, Victoria, British Columbia, in the Water Rights Branch, and I will be tendering that later as an exhibit.

"In 1892 in accordance with the arrangement made with the Government of British Columbia the British Company commenced actual construction of dikes along the boundary of the Kootenay river and around and about that tract of land now known and described as Lot 774, Kootenay District, containing 7,705 acres more or less.

"I produce and tender two copies of a letter from which I will read an extract. This letter is dated Victoria, B.C., August 10, 1894. It is addressed to the Honourable Theodore Davie, Attorney-General for British Columbia, Victoria, B.C., and is signed by G. A. Keefer, C.E., Inspecting Engineer. Without reading the whole of that letter into the record, Mr. Chairman, he states therein:—

"'This work was commenced in the summer of 1892, and has been steadily prosecuted every workable month since that date.

"'With the conclusion of the present year or before the high water of next (1895) we hope to have this portion reclaimed; that is, as affected by the highest known waters previous to the present year. Of the river dike only four miles remain to complete and will be finished this fall, the heavier dike as we hope by next June."

"In another paragraph he says:

"'The diking required to reclaim this property consists of 12 miles of river dike averaging from 5 to 6 feet in height, and three miles of a heavy cross dike averaging some 20 feet in height parallel to the international boundary.'"

"'That, I take it, is the dike referred to as the dike along Boundary creek, along our southerly boundary. He says further:

"'The expenditure in connection with this work since the inception will aggregate not less than $250,000.'"

"Then he states:—

" ' Owing to the unprecedented floods of the present year, our dike in common with all others in the Province, was overtopped and breached in several places, but in addition to the repairs the company have the very serious consideration to face of raising the present dike to a sufficient height to give immunity from the overflow by the repetition of the extreme flood of the present year, which if originally contemplated would have been virtually prohibitory to the undertaking.' "

" ' I wish now to read from paragraph 5 of the application as follows:—By grant from the Crown in right of the Province of British Columbia made and given on or about the 18th day of November, 1894, the British Company acquired title in fee to the said Lot 774.

" ' The British Company had a very large acreage which they were attempting to reclaim, but under the terms of the agreement of 1891 they decided to try a smaller area, and they selected this area now known as Lot 774; and, after negotiation with the Government of British Columbia, a Crown grant was given for it to the British Company.

" ' Paragraph 6, from which I now propose to read is the best information we have available. I understand it may be possible that some of the representatives here to-day will file some information which has not been available to us which will clarify that, but for all practical purposes I do not think it matters.

" ' The British Company made further attempts to restore and complete its reclamation project during the years 1896, 1903 and 1904, and approximately in 1903 and 1904 completed dikes along the international boundary.'

"That refers to dikes along what is now known as Boundary creek.

"Paragraph 7 of the application is incorrect, but I think it is immaterial to make the correction. Subsequent to the operations of 1903 and 1904, at a time of which there is no available record as far as we have been able to ascertain, but apparently between 1904 and 1909—I state those dates because we know certain things which happened in 1904; and, in any event, it was prior to 1909, as the evidence will show—Boundary creek overflowed and cut this new channel along the dikes, making it actually a boundary creek running parallel with if not even exactly along the international boundary.

"The British Company and others with its permission carried on farming operations on Lot 774. There is a portion at the north end of our farm on this Lot 774 which is comparatively high land and on which is situated what is known as the Reclamation Farm House, from which from time to time during the past forty years farming operations have been carried on. The lands have been used for agricultural purposes up to the time the British Company discontinued its farming operations because it was not able to complete the dikes or repair the dikes which had been built in 1892 and 1893. The British Company is still the registered owner of Lot 774.

"In 1930 the farms at the south end of this lot adjacent to the international boundary were flooded. To go back two years, by an agreement certain parties entered into with the British Company, it was agreed that the lands should be sold.

"On the 2nd of May, 1930, an agreement was entered into between the British Company and the Kootenay Valley Power and Development Company for the purchase of the property for the consideration set out. Subsequently the Kootenay Valley Company, as they are called for convenience, entered into an agreement with a number of sub-purchasers whereby they sold them this land in different acreages under conditions set forth and in this agreement they agreed to do reclamation for them by a certain date. The Kootenay Valley Company did not see fit to come before this Commission for permission to do

this reclamation. They were proceeding without that, and with a certain degree of success, with the reconstruction and rehabilitation of the dikes and drainage ditches and farmers located themselves there—about fourteen from south of the boundary line who had been accustomed to farming under such conditions. They planted their crops but in 1930 the farms located on the south end were flooded by reason of high water and insufficiency of the dikes.

"A good crop was obtained from the farms located on the north end of the lot. In 1931 all those who put in their crops obtained very good results. Between June 12, 1931, and the spring of 1932 a considerable sum of money was expended by the Trustee in the instalment of a pumping system. In 1932 the entire area was flooded and no crop was obtained. I think that is enough of the history of the project to show that it has at least some element of difference as compared with the application of any other company that may come forward and apply for approval of a similar project.

Reclamation. "This project, when completed, will result in the reclamation of 7,700 acres and the fertile soil is capable of producing a wheat crop up to 75 bushels to the acre. It has been proved to be capable of producing very valuable crops of peas and other grains, vegetables and possibly small fruits and berries. Some experimentation has been carried on in respect to that matter. When reclaimed it is estimated this land will be worth \$100 to \$150 per acre. As this Commission is aware, there are from 20,000 to 30,000 acres of this delta land in the Kootenay valley reclaimed by the erection of dikes in the State of Idaho along the Kootenay river. No land on the Canadian side has as yet been reclaimed other than the lands of the applicant. The Creston Reclamation Company, Limited, obtained approval of its scheme by this Commission in April, 1928, but it has not yet proceeded with its project, nor have the works proposed in that application been constructed.

Effects of Project. "Dealing briefly with the effect of these proposed works, the evidence will disclose that dyking and the reclamation projects as proposed will, as far as we can estimate, have the following effects:—

(1) It will increase very slightly the elevation of Kootenay lake at high water stages. My learned friend, Mr. Crowe, has already given the figures of the estimate made by his engineers on that, showing what that increase would have been in the year 1916. He gave it as 0·30. We admit our calculations show a slight increase.

(2) We will increase, as far as we can tell, by a very slight amount the elevation of Kootenay river from Kootenay landing, the point at which Kootenay river enters Kootenay lake, to a point at or near Bonners Ferry, at high water stages for a distance of approximately 70 miles up the river. There will be a very slight increase in the elevation of Kootenay river at high water stages.

(3) We will increase very slightly, and only at extreme high water stages, the velocity of the flow in the Kootenay river above Kootenay lake and between Porthill, Idaho and Creston Ferry, British Columbia. That is practically along the eastern boundary of Lot 774.

(4) The construction of the dikes along Boundary creek—not the dikes along the Kootenay river but the dykes along Boundary creek—will affect most directly the lands of Mr. A. Klockmann, whose properties lie along the south bank of Boundary creek in the State of Idaho. The evidence will show—I believe he is here and will speak for himself—that we have agreed with him as to the protective measures which are to be taken in respect to this property. Apart from Mr. Klockmann's lands, the evidence will show that the project will result in no adverse effect of any material consequence, as far as we are able to ascertain, upon any person interested in agricultural production below or

above the area proposed to be reclaimed. Our engineer, in making his calculations, has borne in mind the fact that the Creston Reclamation Company's application was approved by this Commission in 1928. In some of his calculations it was necessary to take that into consideration."

Mr. Lett filed consents on behalf of various public and private interests to the granting of the application.

J. C. MacDonald. Stated on behalf of the Government of British Columbia that it fully approved of the policy of the applicants.

E. M. Tredcroft. The Applicant's Engineer, gave the following evidence as to the physical conditions of the project:—

"The effect of the diking of the Kootenay Reclamation Farm will be that the elevation of Kootenay lake will be raised a slight amount. The amount of this raise will vary according to different years but it will in no year be very great. I have here a summary which shows exactly what will happen during the high water period, based on conditions of 1916, 1926, 1928, 1929 and 1933. The effect of our reclamation of Kootenay Farm, as pointed out by Mr. Lett, will be as follows:—

"In 1933 the elevation of Kootenay lake, at maximum high water which occurred on June 22, would have been raised 0·15 of a foot, or approximately 2 inches. In 1929, under original conditions before any excavation or improvements on the Kootenay river below Kootenay lake, the rise at high water would have been 0·105 feet, equal to one and a quarter inches. In 1928, under present conditions, that is to say if we had a flow the same as in 1928 and the river below Nelson had the same capacity as now, the increase in elevation would be 0·188 feet, equal to a rise of two and a quarter inches. In 1928, under original conditions, or under conditions as they were in 1928, the river below Nelson having the same capacity as then, the increase would have been 0·204 feet, or equal to two and a half inches. In 1926, which was a very low water year, and under the conditions of that time, the increase would have been 0·007 feet, or equal to three thirty-seconds of an inch. In 1916, under 1916 conditions, the increase in elevation would have been 0·23 of a foot. Such elevations are on the days on which the lake was at its maximum elevation.

"On the day during which our work would have the maximum effect on the lake, the increase in elevation would be slightly higher. I have computed this for the years 1916 and 1928. In 1916 on the day of maximum effect upon the lake the greatest rise would have been 0·31, and in 1928 the day of maximum effect was the same as the day on which the lake reached its maximum elevation.

"In addition to increasing the elevation of Kootenay lake, our work will have certain other effects. One of them will be that they will raise the elevation of the water slightly in Kootenay river between Porthill and Creston. There will be a rise in this section of the river for two reasons, one that with the rise in Kootenay lake there will be a certain backing up in the river, and the other that during the high water period the waters of Kootenay river, which flows in a northerly direction and across the international boundary at Porthill, sometimes flow up the mouth of Boundary creek pass in a northerly direction across our land. The additional waters of Kootenay river flow across our land at the mouth of Smith creek, which is the outlet of Boundary creek, and drain into Kootenay river a short distance below Porthill. The effect of closing the dike along the north bank of Boundary creek will be that the waters that formerly flowed across our land will be diverted down the original channel of Kootenay river. . . .

"The increased elevation of the Kootenay river at Porthill, based on the conditions of May 30, 1928, which was the date of the highest elevation at Porthill, would have been 0·53 of a foot, made up in this manner: 0·16 of a foot, the effect of backwater from Kootenay lake, and 0·37 of a foot, the effect

of turning additional water down the main channel. The rise at Copeland would be approximately 0·30 and at Bonners Ferry approximately 0·10. In 1933 on the day of maximum high water the effect would have been to increase the height of the water at Porthill 0·26 of a foot; due to backwater from Kootenay lake 0·12, and due to extra flow 0·14. The effect at Copeland would have been 0·16, and at Bonners Ferry 0·05. In addition there will be a slight increase in the velocity of the river flow between Porthill and Creston due to the extra water to be carried. This increased velocity, in 1928, would have amounted to 0·06, and in 1933 to 0·77 (feet per second). These are the only effects which the diking of our lands will have.

"The elevation along Boundary creek will be 1767, and the elevation of that part of the dike along the east bank of Big Slough will be 1766·5 as referred to Geodetic Survey of Canada, datum 1928."

C. C. French. The following letter, dated at Creston, B.C., August 22, 1933, from C. C. French, setting forth his objections to the proposed drainage scheme, was filed with the Commission:—

"Owing to ill-health in my family I shall be unable to attend the public hearing in the above matter to be held at Nelson, B.C., on the 26th instant, as per your notice to me of the 25th ultimo, and can only refer you to this letter when any questions may arise as to the above company diking through my land on the east side of the Big Slough, and will humbly beg of you to give me full consideration in the matter and protect my interests, as I have put thirty-eight years of my life and hard work and money into my ranch here, and have put up with a good many hard knocks as a pioneer, and no company should be allowed to crowd out or jeopardize the interests so hardly won of any individual.

"I might refer you to the Ryckert and Grohman controversy, which arose when this Kootenay reclamation project first came up, and in which the Government then fully protected Mr. Ryckert's interests. As you doubtless know, the correspondence, etc., in reference thereto is all on file at Victoria, B.C.

"My objections are as follows:—

"*1st. Bridge and Dam.*—I would refer to my letter to you of February 24, 1933, in which I set out in detail where this dam and bridge is located, and some of the reasons for my objecting thereto. I might add that had the high water been able to have flowed out naturally as it had done previously before this dam was constructed it would not have taken out my bridge, as it had withstood high water until this dam near the Johnston point was constructed, and I hereby object to this dam as being a menace to my own and wife's interests here, as well as to the interest of the general public, as there is no doubt but what the accumulation of debris, etc., from the breaking of this dam was the main cause of the Government bridge, situated about a mile north from my place on the Big Slough, being swept away during high water this spring. This bridge serves a great many people both to and from Creston, and has had to be reconstructed recently by the Government and traffic has been held up for some months and a great many people inconvenienced in getting their produce to and necessities from town.

"*2nd: Overflow of Water on Land.*—My wife and I have about 80 acres on the west side of the Big Slough, between it and the mountain, which would be affected by the overflow if this company should dike through our land on the east side, which will make it imperative for us to dike our land on the west side which we are not financially able to do. This is the same class of land which this company is diking and they seem to wish to depreciate our land and add to their own by diking in this manner, as the small amount of our acreage which they purpose including in their dike is not anywhere equal to the amount of injury they are doing us in diking in this manner.

"If the dike had been constructed where the original Alberta and British Columbia Reclamation Company had the charter to put same, it would not be a menace to anyone but a benefit to all, as it could have served as a public crossing of the Big Slough at the north end of the reclamation holdings, whereas, if it is constructed up the east side of the Big Slough it will always be a menace to us and the public in general.

"In the light of all this I humbly pray that you will consider this matter most carefully and give the general public as well as myself and wife full protection."

Mr. Lett in his comments on Mr. French's letter emphasized the point that Mr. French's property and the property of the applicants lay entirely within Canada and that therefore any matter of dispute between them was a question for decision by the courts of the province.

Mr. Tredcroft explained the physical relationship between Mr. French's interests and those of the applicant. He said:—

"Mr. French's property is located north of the Big Slough. A portion of it extends across the slough in a southerly direction and includes an area of approximately 24 acres. When this project was originally commenced the proposal was to build the dike across the Big Slough in the vicinity of Twin bridges. If that had been done Mr. French's property would have been reclaimed. However, when we came to investigate putting a dike across the mouth of Big Slough we found there were certain objections to it. One objection was that the location of the dike would have to be right where Big Slough joined the Kootenay river and where a steep drop off from Big Slough into the bed of Kootenay river occurred. There was the danger, therefore, that the foundation of this dike might some time during high water slump off.

"In addition there are two creeks which run into Big Slough approximately one-third and two-thirds above its mouth. The flow of these creeks has never been recorded; and, while they are not high ordinarily, they can be very considerable during the freshet period. As the dike at the mouth of Big Slough would have had to be far higher than the bed of Big Slough we should at times have had to pump all the water from both of these creeks, which meant a heavy annual charge in operating costs.

"I may say that at the time there was considerable argument as to which method was correct. Mr. French claimed that a dike across the Big Slough at its mouth was the only logical method of reclaiming these lands. Certain other parties also took his side. The trustee, therefore, obtained the opinion of a prominent engineer from Boise, Idaho, Mr. Carter. Mr. Carter made a fair examination of conditions and gave it as his opinion that conditions were all favourable to diking out Big Slough. He therefore recommended that in accordance with my original recommendation. It is still a matter of dispute with Mr. French just where this dike should go. The trustee has offered Mr. French what I consider a very reasonable price for his land on the east side of Big Slough, which, as I have previously said, is very small in area. . . .

"Mr. French also claimed that by putting a dike along the east end of Big Slough we would raise the water on his property. Big Slough will be under our proposed diking open to the Kootenay river, as it has always been except for three occasions, when they attempted to construct dikes across it, all of which failed.

"I believe Mr. French does consider that he is seriously affected; but my opinion is that the trustee has offered him far more for permission to construct a dike along his property than the land is worth. . . . There is none of his land affected, except that which we would be required to purchase from him as a right of way for our dike."

Mr. Lett in concluding his presentation on behalf of the applicants said:—

"The proposal is to proceed and to complete the reclamation immediately. The trustee has arranged his finances and he is in a position to start that work directly approval is given. If it were a matter of a new plan we were starting perhaps the Commission would require to give it fuller consideration. It has already been before the Commisison for some time. We have made the purpose of the applicant clear and shown that the position of the farmers is such that, if I may make so bold as to suggest it, approval is not only urgent but vital. If we can get approval in time to build the dikes immediately, as we are prepared to do, these dikes will have a chance to set, to cure, before the next high water starts. I think it is evident, there being no objection, that no one can be damaged by this undertaking, and that on the other hand there is evidence that this reclamation project will be of great benefit to the district and to the parties concerned. The trustee in this application represents the interest of the creditors of a bankrupt estate. I suggest that if it were possible for the Commission to give approval to the application at its earliest convenience it would confer a great benefit on a good many parties. I think the danger of immediate approval being taken as a precedent is very slight since the peculiar situation which I have outlined at some length brings out this case distinctly as one of rehabilitation and not one involving a new project."

J. E. Read. Mr. J. E. Read filed exhibits on behalf of the Canadian Government and said:—

"When the matter was first brought to the attention of the Government of Canada by or on behalf of the trustee it was examined and the view taken by us was that it was an existing project and that technically the applicant might be entitled to proceed without bringing it before the Commission. But, on the other hand, we agreed with the applicant that in a case where the matter was so near the border line and debatable, it was better that it should be brought before the Commisison and cleared up. But I would like the Commission, in considering whether it will give approval to this application, to give weight to the fact that this is really a case of reviving an existing project which has been in existence, off and on I may say, for a very long period of years."

J. T. Johnston. Mr. J. T. Johnston made the following statement on behalf of the Department of Indian Affairs of Canada:—

"The undersigned has been authorized to present the viewpoint of that department with respect to the effect of the proposals of the Applicant. . . . .

"The Department of Indian Affairs is prepared to accept the analysis of the effect of the company's proposals upon the water levels of Kootenay river as prepared by the technical officers of the Department of the Interior and as submitted to the Commission to-day.

"The Department of Indian Affairs does not consider that the moderate backing up of the Kootenay river water level at the international boundary as indicated by the results of investigations made by the engineers of the Dominion Government and filed herewith with the International Joint Commission in connection with the Trustee's application, i.e., a maximum backing up of 0·30 to 0·5 foot opposite Indian Reserves Numbers 5 to 1-A, respectively, will in any wise injuriously affect the Indian lands on the Kootenay Flats.

"The Department of Indian Affairs is, therefore, prepared to concur in the approval of the Trustee's proposals as submitted to the Commission."

A. Klockmann. Mr. A. Klockmann made a statement in connection with the protest of Mr. French. "It so happens," he said, "that Mr. French, his son and wife have for years worked for me on my ranch. He comes back and forth quite often. On a visit about a week ago he approached me to try to effect the

sale of 24 acres of land to the parties who are interested in this reclamation. I asked him what price he wanted and he told me $100 an acre. I said to him, 'French, you are entirely out of reason.' We are selling our land for $15 an acre and the highest it has ever been is $40 an acre. I know this ranch and I know it is a piece of swamp. I wanted to tell you this now because I am convinced that if they leave it to me and if they get the approval now, this important reclamation can go ahead at once. I will undertake to make some settlement with Mr. French for the applicants if they want me to."

J. A. Metzger. Mr. J. A. Metzger made the following statement on behalf of the Government of the United States:—

"I have three exhibits which I desire to introduce. They are prepared with special reference to some statements that were made in the original application for the permission which is sought in this hearing. I consider that some of the statements are inaccurate and while I do not desire to make a point of it, looking ahead and not being able to foresee what may arise in the future, I deem it desirable to put in with the Commission at this time documents which I find in the Government's records relating to the dikes which were placed at the boundary first across Boundary creek and later extended to the Kootenay river. I may say these documents show that Boundary Creek originally came down from the mountains and crossed the boundary very near the mountains. That crossing was diked off, diverting the waters of Boundary creek into Idaho, and they found their way eventually into the Kootenay river through Smith creek. Later, as has been explained, the dyke was extended across to the river and borrow pits were dug partly on the United States side of the line and the creek eventually found its way to the river through those borrow pits. The matter was the subject of correspondence between the two Governments, between the Department of State and the British Embassy at Washington, beginning April 17, 1895. The Secretary of State addressed a communication to the British Ambassador on that date. A series of correspondence was exchanged. I do not care to make a point of it but I desire to have the matter of record."

The other two exhibits consist of maps showing the original course of Boundary creek on a United States map and a Canadian map.

Mr. Metzger offered the following comments on the application of certain Articles of the Treaty to the case under consideration:—

"I want to call attention to Article IV of the Treaty, which I think includes only obstructions placed in streams below the boundary, so that the Treaty would not include that kind of work.

"There is another provision of the Treaty to which I desire to call attention and it is the next to the last paragraph of Article VIII, which I will read:—

"'In cases involving the elevation of the natural level of waters on either side of the line as a result of the construction or maintenance on the other side of remedial or protective works or dams or other obstructions in boundary waters or in waters flowing therefrom or in waters below the boundary in rivers flowing across the boundary, the Commission shall require, as a condition of its approval thereof, that suitable and adequate provision, approved by it, be made for the protection and indemnity of all interests on the other side of the line which may be injured thereby.'

"In considering this application, I think it important that attention be given to that provision of the Treaty. This is all I have to offer."

R. W. Davenport. Mr. Davenport filed a report, on behalf of the United States, embodying certain studies of the effects of the dikes present and prospective on increasing the flood heights of the Kootenay river.

In reply to a question as to the probable effect of the Creston works on the level of the river south of the boundary, he said:—

"My calculations are based on the 1927 flood because in that year there happened to be data collected on the Canadian side which were very useful in making the calculations. Assuming that both the Creston and Reclamation Farm projects are constructed I find that the peak height of 1927 would have been raised slightly more than one foot at Porthill, decreasing to slightly less than one foot at Bonners Ferry, with an average of about one foot in Idaho."

Mr. Stanley said: "As I remember the War Department, investigating originally matters of navigation, discussed this diking proposal. One or more of the engineers read a statement to the effect that if the dikes or improvements north of the boundary should be higher than the present dikes on the land in Kootenay flats they would have a tendency naturally to cause the river to over-top those dikes."

Mr. Davenport replied: "My study which is covered in the report shows my conclusion as to the effects of such diking as has been done in Idaho in the past towards increasing flood heights. Of course, at Porthill there is no effect. It increases to the maximum effect near Bonners Ferry. The increased height for a large flood due to present diking would be about one and one-half to two feet."

Mr. Stanley asked if this would be at Bonners Ferry and Mr. Davenport said:—

"Yes, that is, with the completion of both this project and the Creston property. Without reference to the present diking in Idaho but on top of that I would estimate there might be approximately one foot if both the Reclamation Farm and Creston projects are completed."

Mr. Stanley asked: "Will you explain to the Commission why that would result from the completion of both projects rather than from the completion of either one?"

Mr. Davenport replied: "The Creston project, if completed, as I understand it, would prevent Goat river from going northward through the flats and would turn it into the Kootenay river south of the boundary. The diking for the Creston project would also shut off a point known as False Mouth of Goat river where, at least during the higher periods of floods, there is considerable inflow from the main channel of Kootenay river, thus relieving the flood burden of the channel. If the Creston project is constructed, that flow will be kept in the main channel of the river."

Mr. Stanley asked on which side of the river was the Salter (Reclamation Farm) project, and on which side the Creston project, to which Mr. Davenport replied: "For some distance they are directly opposite, for approximately a mile and a half they would be."

Sir William Hearst asked: "Is there any compensation with reference to the river level which this project would give as compared with the Creston project?"

Mr. Davenport: "I could not answer that; I did not consider it personally. There is a menacing condition at the boundary where there is a flow out of the main channel of Kootenay river under present conditions, which, with the construction of the boundary dike would be prevented. Such flow would be carried on down the main channel of the river."

Returning to the question of the effect of the Treaty, Sir William Hearst said: "Just one more word, Mr. Metzger. You called the attention of the Commission to the provisions of Article VIII, which says that as a condition of the Commission's approval, suitable and adequate provisions approved by the Commission, be made for the protection and indemnity against injury of any interests on either side of the boundary. I do not take you as suggesting that any interests on the other side of the line will be injured that will require protection."

Mr. Metzger replied: "It has been brought out, of course, that the peaks of high water will be probably a foot greater by reason of these works, and I would not be prepared to say that that would result in damage. No one has claimed to be injured by it. I know of no claim being made. However, I felt that it was my duty to call attention to the provision."

Exhibits. A list of exhibits filed at the Nelson hearing in this case will be found in Appendix G.

Temporary Order. Immediately after the public hearing in Nelson the Commission held an executive session at the same place, and in view of the importance of the applicant going ahead with the proposed works without delay, the following communication dated August 26, was addressed to the Solicitor for the Trustee in Bankruptcy:—

"I am instructed to inform you that the International Joint Commission has decided to approve your application for permission to rehabilitate, reconstruct and repair certain permanent works in and adjacent to the channel of the Kootenay river and to construct and maintain certain permanent works in and adjacent to Boundary creek in the Kootenay District of the province of British Columbia.

"This approval is subject to such reservations, qualifications and conditions as the Commission may deem proper to embody in its formal order, one of which conditions shall be that the permission and order shall in no way affect or prejudice the rights and remedies of adjoining owners or of any person who may be injured by the construction of said works.

"If you desire to amend the plans and specifications attached to your application, as intimated by you to-day, you are requested to do so without unnecessary delay.

"In the meantime, you may take this letter as authority to proceed with your works."

Order of Approval. At its regular semi-annual session in Ottawa, the Commission adopted and signed an Order of Approval, which, omitting the title, is as follows:—

WHEREAS, the Kootenay river is a river flowing across the boundary between Canada and the United States within the meaning of Article IV of the Treaty between the United States and Great Britain dated the eleventh day of January, 1909; and

WHEREAS George Leonard Salter, Trustee in Bankruptcy of the Kootenay Valley Power and Development Company, Limited, has presented to and filed with the Commission an application for permission to rehabilitate, reconstruct and repair certain permanent works in and adjacent to the channel of the said Kootenay river and to construct and maintain certain permanent works in and adjacent to the channel of Boundary creek in the Kootenay District, in the province of British Columbia in the Dominion of Canada, said works to be mainly upon Lot 774 Kootenay District in the province of British Columbia, in accordance with specifications and the two plans referred to in said application and filed therewith as a part thereof; and

WHEREAS said application came on for hearing at the city of Nelson in the province of British Columbia on the 26th day of August, 1933, after due notice to all parties interested in both countries of the filing of said application, and of the time and place of said hearing, when evidence was adduced, exhibits filed and all parties so desiring were heard; and

WHEREAS the following parties appeared before the Commission at said hearing, namely:—

Sherwood Lett, Counsel for and representing the Applicant;

E. H. Tredcroft, Hydraulic Engineer, representing the Applicant;

J. A. Metzger, of the Department of State, Washington, Counsel for and representing the Government of the United States;

J. E. Read, Legal Adviser of the Department of External Affairs, Ottawa, and Counsel for and representing the Government of Canada;

R. C. Crowe, Counsel for and representing the West Kootenay Power and Light Company, Limited;

G. E. Clark, District Counsel for the United States Indian Irrigation Service;

J. T. Johnston, Ottawa, of the Department of the Interior of Canada, representing the Canadian Government and the Department of Indian Affairs of Canada;

A. J. Matheson of Ottawa, and C. E. Webb of Vancouver, representing the Dominion Water Power and Hydrometric Bureau of the Department of the Interior, Canada;

J. C. MacDonald, of Victoria, Comptroller of Water Rights, representing the Government of British Columbia;

A. L. McCulloch, representing the Creston Reclamation Company, Limited;

R. W. Davenport, Senior Hydraulic Engineer of Washington, representing the United States Geological Survey; and

WHEREAS on the opening of the hearing counsel for said West Kootenay Power and Light Company, Limited, who had filed a Response and protest against the granting of said application, withdrew the protest and objection of said company; and

WHEREAS the following parties have approved of and consented to said works, as appears by their written consents filed with the Commission, namely:—

The Department of Indian Affairs of Canada;

The Comptroller of Water Rights of the Province of British Columbia;

The Alberta and British Columbia Exploration Company, Limited, legal owner of the property mentioned in the application;

A. Klockmann of Porthill, Idaho, the owner of lands on the other side of the international boundary line immediately adjoining the lands mentioned in the application;

Kootenai Valley Reclamation Association, representing Districts Numbers 1 to 13 in the State of Idaho; and

WHEREAS, except as aforesaid, no objection or protest has been raised by anyone to the granting of the authority asked for by the applicant, other than by one C. C. French, the owner of certain lands in the province of British Columbia in the Dominion of Canada, adjacent to the lands mentioned in said application, who filed a letter at said hearing objecting to the granting of the application on the ground that the proposed works would injuriously affect the lands owned by him; and

WHEREAS it has been made to appear to this Commission that the lands owned by said C. C. French are situated wholly within said province of British Columbia and within the jurisdiction of the courts of that province; and

WHEREAS it has further been made to appear to this Commission that although the applicant proposes to construct certain new works, the application

is primarily for the rehabilitation of works constructed a number of years ago, prior to the date of the above-mentioned Treaty, upon which works the sum of $250,000 or thereabouts has been expended; and

WHEREAS it has further been made to appear to this Commission that the only interests on the other side of the boundary which can be injured by the said works, are the interests of the said A. Klockmann as owner of the lands in the State of Idaho opposite the lands mentioned in the said application, and the interests of Reclamation Districts Numbers 1 to 13 in the State of Idaho represented herein by the Kootenai Valley Reclamation Association; and

WHEREAS the said A. Klockmann and the said Kootenai Valley Reclamation Association have given their written consents to the construction of the said works and the granting of the said permission, and the said A. Klockmann further personally appeared before the Commission and gave his approval to the granting of this order; and

WHEREAS the applicant has presented to and filed with the Commission amended plans of said works on three sheets hereinafter referred to as the "amended plans"; and

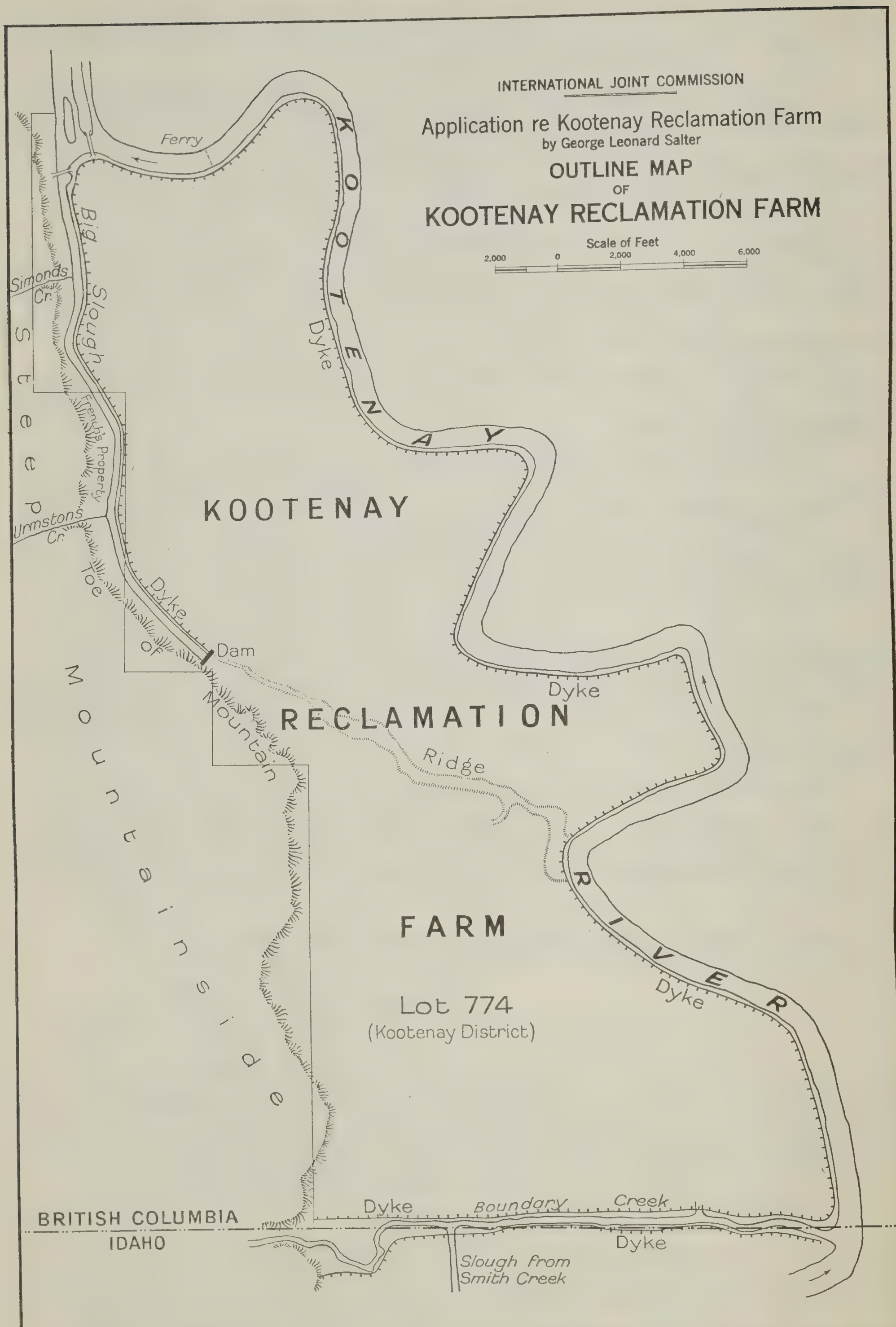
WHEREAS the members of this Commission after having read said application and specifications and perused said plans and amended plans, and having heard the evidence adduced, and having read the exhibits filed, and what was alleged by all parties appearing before them as aforesaid, and having considered the matters above recited, have determined that the said works should be approved of and authority given for the construction thereof pursuant to said Treaty;

1. THIS COMMISSION THEREFORE ORDERS AND DIRECTS that the said plans and specifications referred to in said application presented to and filed with the Commission as aforesaid, as amended by said amended plans (copies of which application, plans, specifications and amended plans are annexed hereto and made a part of this order) be, and the same are, hereby approved of, and the construction of works in accordance therewith authorized under the provisions of said Treaty.

2. AND THIS COMMISSION FURTHER ORDERS AND DECLARES that nothing in this order contained shall in any way prejudice, impair or affect the position, rights or remedies of the said C. C. French in respect of any injuries, damage or loss he may sustain, suffer or be put to by reason of said works or otherwise howsoever.

Dated at Ottawa, this third day of October, A.D. 1933.

(Signed) C. A. MAGRATH,
A. O. STANLEY,
W. H. HEARST,
JOHN H. BARTLETT,
GEO. W. KYTE,
EUGENE LORTON.


INTERNATIONAL JOINT COMMISSION
Application re Kootenay Reclamation Farm
by George Leonard Salter
OUTLINE MAP
OF
KOOTENAY RECLAMATION FARM
Scale of Feet
2,000 0 2,000 4,000 6,000
Ferry
KOOTENAY RIVER
Dyke
Big Slough
Simonds Cr.
Steep Mountainside
French's Property
Urmstons Cr.
Toe of Mountain
Dam
KOOTENAY
RECLAMATION
FARM
Ridge
Lot 774
(Kootenay District)
Boundary Creek
BRITISH COLUMBIA
IDAHO
Slough from Smith Creek

VI

WATER-POWER DEVELOPMENT

Hydro power development in the Kootenay drainage basin has had much to do with the development of the mining industry in that area. Numerous small water-power plants have been installed at rapids or falls on tributaries to the Kootenay river and Kootenay lake from time to time. Some of these still operate while others have been abandoned when the particular mine being supplied with the power became worked out or ceased to pay its way. In addition to these plants of a few hundred or less horse-power each, the mining industry is responsible for several larger developments with installations in plants on the Kootenay river itself ranging up to 75,000 horse-power. The most important power developments are referred to individually hereunder.

In the first division of the Kootenay river drainage system or that part from its source southward into Montana and to the vicinity of Bonners Ferry, Idaho, there are no power developments on the main river. However, some of the power sites on the tributary waters have been developed.

Consolidated Mining and Smelting Company Limited. The Consolidated Mining and Smelting Company operates a plant on Mark creek, a tributary to the St. Mary river, from which it obtains a part of its power needs in connection with its operations at the Sullivan mine and its concentrating mill at Kimberley. At this development water is diverted, by means of a small dam, through a 30-inch wood-stave pipe line, 4,450 feet long to three 72-inch Pelton water-wheels in the compressor house at the mine plant under a head of 183 feet to develop approximately 500 horse-power.

East Kootenay Power and Light Company, Limited. In 1922 the East Kootenay Power and Light Company, Limited, completed the construction of a hydro power plant on the Bull river, some 8 miles from Bull River station on the Canadian Pacific Railway. This development consists of a reinforced concrete dam 100 feet long and 11 feet high with an earth fill extension of the same length and height from above which the water is carried through a 7-foot wood-stave pipe line for a distance of 8,600 feet to a surge tank from which a riveted steel penstock 504 feet in length leads to the power-house. This latter is equipped with two 3,600 horse-power turbines operating under a head of 275 feet. The output of this plant is distributed to Kimberley, Cranbrook, Fernie and the intermediate mining areas and as far east as Bellevue, Alberta.

In 1923 the East Kootenay Power and Light Company, Limited, constructed a second hydro plant, this time on the Elk river, 1 mile south of Elko on the Crow's Nest Branch of the Canadian Pacific Railway. The development consists of a reinforced concrete diversion dam 300 feet long with a maximum height of 50 feet from which a 12-foot diameter wood-stave pipe line 1,200 feet long connecting with a tunnel 2,000 feet long leads to a surge tank and power-house where two vertical type turbines of 7,500 horse-power each operate under a head of 190 feet. The output of this plant augments that from the Bull River development of this company and is distributed at Kimberley, Cranbrook, Fernie and in the intermediate area.

The second section of the Kootenay river drainage system, or that part tributary to Kootenay lake has not as yet experienced any large hydro-electric developments but a few small ones are in operation on the tributaries.

Kootenay Electric Company. In 1897 the Kootenay Electric Company developed a site near the mouth of Kaslo creek one and a half miles above the town of Kaslo, British Columbia. A new generator was installed in 1907 and in 1915 the plant was purchased by the municipality of Kaslo. The power-house contains one 250 horse-power turbine operating under a head of 40 feet.

Town of Bonners Ferry, Idaho. In more recent years the Town of Bonners Ferry, Idaho, has installed a 650 horse-power turbine in a plant on Myrtle creek and a 500 horse-power turbine in a development on the Moyie river. Myrtle creek joins the Kootenay a short distance below the town of Bonners Ferry, while the Moyie river joins it a short distance above the town.

West Kootenay Power and Light Company, Limited. In 1933 the West Kootenay Power and Light Company, Limited, constructed a hydro plant on the Goat river near Erickson, British Columbia. This plant is equipped with one 250 horse-power unit and one 800 horse-power unit or a total of 1,050 horse-power. It operates under a head of 70 feet.

The third section of the Kootenay river from the West arm of Kootenay lake to the Columbia river comprises one of the most important power streams in British Columbia. In this twenty-mile reach the river falls some 330 feet, of which some 263 feet have been developed for power production at four concentrations.

Not only is the reach of the river endowed with the head necessary for power development but the flow is much larger than in the upper reaches due to the greater tributary area which it drains. Of equal importance from a power production standpoint, the discharge, during the winter months of low run-off, is augmented by the natural storage which occurs in Kootenay lake.

The West Kootenay Power and Light Company, Limited, has four plants in operation in this section of the river; at Corra Linn rapids, at Upper Bonnington Falls, at Lower Bonnington Falls and at South Slocan, respectively, in downstream order. Power from these plants is widely distributed for use in municipalities and the mining industry. The city of Nelson also operates a plant at Upper Bonnington Falls and distributes power for municipal, industrial and mining purposes. In the same area but on the tributary waters of Sandon creek, the town of Sandon operates a small hydro-electric plant for lighting purposes. These different water power plants are referred to hereunder in order of their development.

Sandon Creek. The plant of the Sandon Water Works and Light Company on Sandon creek was installed in 1896. It consists of a 175 horse-power Pelton single runner operating under an average head of 410 feet. The power is used for lighting only, in the town of Sandon.

Lower Bonnington Falls Station. The Lower Bonnington Falls station of the West Kootenay Power and Light Company, Limited, located about 11 miles downstream from Nelson, was first constructed in 1897 with two 1,184 horse-power units and one 1,648 horse-power unit added in 1899, operating under an average head of 37 feet. This plant was completely demolished in 1923-24 and was replaced by a development consisting of a crib-work dam which crosses the river diagonally from the south shore in a down-stream direction to meet a concrete section at the entrance to the canal leading to the reinforced-concrete power-house adjacent to the north bank of the river. The plant is equipped with three 20,000 horse-power units operating under an average head of 70 feet.

Upper Bonnington Falls Station. The Upper Bonnington Falls station of the West Kootenay Power and Light Company, Limited, is located about one mile above the Lower Bonnington Falls plant. The reinforced-concrete power-

house is adjacent to the north bank of the river and a diversion dam of rock-filled timber cribs leads diagonally upstream to meet and form a V shape with the similar dam of the city of Nelson plant on the south shore. The plant was installed in 1906 with two 8,000 horse-power units. Two additional units of 9,000 horse-power each have since been added, one in 1914 and the other in 1916. The total installation is therefore 34,000 horse-power. The units operate under an average head of 70 feet.

City of Nelson Plant. The city of Nelson plant on the south bank of the Kootenay river at Upper Bonnington Falls was constructed in 1907. A wing dam connecting in mid-stream with the similar wing dam of the West Kootenay Power and Light Company plant on the opposite shore diverts the water to the power house. One 1,670 horse-power unit was installed in 1907, an additional unit of 1,900 horse-power was added in 1909 and in 1929 a third unit of 3,000 horse-power was added, giving a total installation of 6,570 horse-power. The plant operates under an average head of 60 feet. This development on the Kootenay river replaced a 500 horse-power waterwheel, developing power with water diverted from Cottonwood-Smith creek, which the city acquired from the Nelson Electric Light Company in 1898. The earlier plant has since been dismantled.

South Slocan Plant. The South Slocan plant of the West Kootenay Power and Light Company, Limited, located on the Kootenay river about one mile below the Lower Bonnington plant was installed in 1928. The power-house is of reinforced concrete and concrete dams extend diagonally upstream from either end to maintain the head and direct the flow to the intakes. The plant is equipped with three 25,000 horse-power units or a total installation of 75,000 horse-power, operating under an average head of 70 feet.

Corra Linn Plant. The Corra Linn plant of the West Kootenay Power and Light Company, Limited, located at Corra Linn rapids on the Kootenay river about $1\frac{1}{2}$ miles upstream from the company's Upper Bonnington plant, was constructed in 1931. At this point a reinforced-concrete dam 1,734 feet long and containing fourteen 34-foot sluice openings reaches from the south shore of the river to the power-house adjacent to the north bank. The dam impounds the water above and drowns out the Corra Linn, Beasley, Taghum and Granite rapids to create a head of 53 feet at the plant. The power-house is equipped with three units of 1,900 horse-power each, giving a total installation of 57,000 horse-power.

In addition to these four developed concentrations on this section of the Kootenay river there remains a fifth possible concentration at Brilliant near the mouth of the river, where the West Kootenay Power and Light Company, Limited, plan to develop at some future date a head of some 80 feet during low water. During periods of high run-off the head at this site is reduced by backwater from the Columbia river.

VII

GRANITE DAM

On September 13, 1929, Hon. Charles Stewart, Minister of the Interior of Canada transmitted to the Commission the Application of the West Kootenay Power and Light Company, Limited, dated September 6, 1929, for permission to construct and operate certain permanent works in and adjacent to the channel of the Kootenay river, for storage purposes, at Granite, British Columbia, with the request that the Commission take appropriate action. The application was filed in the office of the Commission on September 16. (Appendix H.)

The application was communicated to the Washington office of the Commission and on October 31, 1929, the United States Secretary transmitted a telegram from F. G. Doherty, Vice-President and General Counsel of the Great Northern Railway Company as follows:—

Great Northern Railway. "Great Northern Railway protests against granting application West Kootenay Power and Light Company Limited for permission to construct and operate certain permanent works in and adjacent to channel of Kootenay river for storage purposes at Granite, British Columbia, upon ground that proposed project would raise elevation of water in vicinity Bonners Ferry and injure Great Northern grades and right of way and would also injure diking projects and flood valuable agricultural low-land in that vicinity served by Great Northern."

British Columbia Government. Under date of November 2, 1929, a communication was received from the Deputy Minister of Public Works of the Province of British Columbia stating that: "The department has no objections to offer to the proposals of the West Kootenay Power and Light Company for permission to construct certain works in and adjacent to the channel of the Kootenay river for storage purposes at Granite, British Columbia."

United States Geological Survey. On October 31, 1929, N. C. Grover, Chief Hydraulic Engineer of the United States Geological Survey, filed with the Commission copies of a statement prepared by the Geological Survey in respect to the application. Subsequently an appendix to this statement was filed at the hearing. (See Appendix I.)

Idaho Statement in Response. There was also filed a Statement in Response on behalf of the State of Idaho and Drainage Districts 1 to 11 of the County of Boundary in the State of Idaho. (See Appendix J.)

Bonners Ferry Hearing. Pursuant to notice to interested parties, a public hearing was held in the town of Bonners Ferry, Idaho, on November 6, 1929. The following appearances were announced:—

R. C. Crowe, Trail, B.C., representing the Applicant, West Kootenay Power and Light Company, Limited.

J. A. Metzger, Washington, D.C., representing the Department of State of the United States.

R. W. Davenport, Washington, representing the United States Geological Survey.

C. G. Paulsen, representing the United States Geological Survey.

J. T. Johnston, Ottawa, Canada, representing the Department of the Interior, and also the Department of Indian Affairs of Canada.

A. J. Matheson, Ottawa, Canada, representing the Dominion Water Power and Reclamation Service of Canada.

C. E. Webb, Vancouver, B.C., Engineer in Charge of the British Columbia District of the Dominion Water Power and Reclamation Service.

P. E. Doncaster, Nelson, B.C., District Engineer, representing the Department of Public Works of Canada.

E. Davis, Victoria, British Columbia, representing the Comptroller of Water Rights of the Province of British Columbia.

George N. Carter, Boise, Idaho, Commissioner of Reclamation of the State of Idaho.

W. D. Gillis, Boise, Idaho, Attorney General of the State of Idaho.

Fred J. Babcock, Boise, Idaho, Assistant Attorney General of the State of Idaho.

John E. Blair, Spokane, Washington.

Ernest E. Sergeant, Spokane, Washington, representing the Great Northern Railway.

O. C. Wilson, Bonners Ferry, Idaho.

Victor H. Greisser, Spokane, Washington, representing the Washington Water Power Company.

L. R. Coffin, representing the Puget Sound Power and Light Company.

Idaho. Counsel on behalf of the State of Idaho and the Drainage Districts presented a formal application for extension of time within which to file a Supplemental Statement in Response, and Mr. Wilson explained the reasons why this was considered necessary. The Attorney General of Idaho followed to the same effect, and also Counsel for the Great Northern Railway. After statements had been heard on behalf of the applicants, the Commission went into executive session, and when the public hearing was again convened the announcement was made by the chairman that the hearing would be proceeded with, the applicants would proceed with the presentation of their case, and that all interested parties would be given the fullest opportunity of putting in testimony either oral or written.

R. C. Crowe. R. C. Crowe, Counsel for the Applicant, submitted a general map showing the watershed of the Kootenay river and a chart giving the elevations of the river at Nelson through a period of years. He set forth the Acts of incorporation of the applicant company, its capital and assets, its board of directors.

By its Act of Incorporation the company is empowered to "acquire and hold water records and to develop power therefrom for transmission and sale within an area comprised within a radius of 150 miles from the city of Rossland, in the province of British Columbia, holds several water licences from the province of British Columbia, entitling it to the use of the water of Kootenay river at Bonnington Falls and South Slocan, some 12 to 15 miles below the city of Nelson, up to 10,400 c.f.s. This water is already being used three times on Kootenay river by being passed through the water wheels of No. 1 Power Plant at Lower Bonnington Falls, No. 2 Power Plant at Upper Bonnington Falls and No. 3 Power Plant at South Slocan, the total developed capacity of the said three plants being 170,000 horse-power, the power so developed being the mainstay of the cities, communities and industries of the southern interior of British Columbia, and supplying such towns and cities as Trail, Rossland, Grand

Forks, Penticton, Kelowna and Princeton, and the principal industries in the communities, more particularly the Consolidated Mining and Smelting Company of Canada Limited, with the necessary power for its smelters and refineries and other metalliferous plants at Trail, and the Granby Consolidated Mining, Smelting and Power Company with its copper mines and concentrator at Copper Mountain near Princeton, in addition to which a considerable amount of power is used in the Okanagan and the Grand Forks district for pumping water for irrigation of agricultural lands.

"The water of the Kootenay river between Nelson and the Columbia river has a drop of some 300 feet, a great deal of which occurs between Upper Bonnington Falls and South Slocan and which has now been entirely utilized.

Storage Principle. " This Honourable Commission has had several problems to deal with where the water levels of either boundary waters or waters flowing from one country to another across the boundary have been affected, and in most cases the question of the storage of water has been an important one, and in these cases it is to be noted from proceedings held before this Honourable Commission that the principle of storing water so as more or less to equalize the flow of rivers has been considered of great importance, the underlying principle naturally being, as it should be, to conserve the power that nature has provided, so that the greatest benefit may be derived from it to the communities as a whole, whether they are on the Canadian or the United States side of the line. This necessity for storage has, in nearly all cases, arisen because of the fact that at certain periods of the year the waters of the rivers are at a flood peak caused by the melting of snow accumulated in the mountains during the winter season; and at a later time in the year the flow of such rivers has so greatly decreased as to make it desirable for a successful power development to conserve some of the flood waters in the natural storage basins contributory to the lakes or rivers from which said waters flow. The application before you to-day is for storage for the same reason.

"As recited in the application, the Kootenay river has its source in the Rocky mountains in eastern British Columbia, flows southerly into the United States of America, passing through the states of Montana and Idaho, and thence it again flows northerly back into British Columbia, crossing the boundary line in the vicinity of Port Hill, Idaho, and discharges its waters into Kootenay lake. This lake has an area of 170 square miles and provides a natural storage basin of about 113,075 acres, which will give us, then, at the 6-foot storage line, 678,450 acre feet of water. At or near Proctor, British Columbia, the water of the Kootenay lake passes into what is known as the West arm of Kootenay lake, and after passing through the West arm and past the city of Nelson, the said West arm emerges into a continuation of the river again at or near Grohman creek. After a 20 mile stretch of river from Grohman creek, the Columbia river is joined about 30 miles north of the international boundary line, and the waters of the Kootenay river, now flowing in the Columbia river, pass southwards, crossing the international boundary line into the state of Washington and finally find their outlet in the Pacific ocean below the city of Portland, Oregon.

Power Sites. " In addition to the power developments in the Kootenay river above mentioned there are several very valuable power sites on the Columbia river, in the state of Washington, particularly that of Kettle Falls, which is owned and is going to be developed by the Washington Water Power Company, and a large development on the Columbia river also, at Rock Island, near Wenatchee, which is owned and is to be developed by the Puget Sound Power and Light Company, Limited. Any equalization of the flow of the Kootenay river by storage of water in Kootenay lake will mean a proportionate

equalization of the flow of the Columbia river, to the great benefit of these last mentioned Washington power projects. Nature has placed at or near Grohman creek a natural weir consisting of coarse gravel and rock that causes the water of Kootenay river to be impounded behind it in the West arm of the lake, and this, in conjunction with a similar natural dam or weir at Proctor, is the natural cause of there being a lake on what would have otherwise been a river. The control, then, of the West arm and Kootenay lake comes naturally from this natural obstruction at Grohman and Proctor narrows. The removal of any part of these natural obstructions, or in other words the enlarging of the cross-section of the river at Grohman creek and at Proctor narrows, must naturally have the effect of reducing the level of the lake.

"Records have been kept of the levels of Kootenay lake and the flow of the Kootenay river by different departments of the Provincial and Dominion Governments and by the applicant, and these records show that the lake and river reaches its minimum flow in the month of January, which minimum flow continues on an average, to the middle of March or the first of April, when the waters begin to rise, sometimes at a very rapid rate, until the flood crest is reached sometime (varying in accordance with the season) between the first of May and the first of July, when the waters recede again fairly regularly until the minimum period in January and February. During the months of May, June, July and August, there is a great excess of water going down the Kootenay river far and above the amount required to operate the aforesaid power plants; then in the months of November, December, January, February and March, the amount flowing is far from being sufficient to operate such plants.

"It is possible to store a large part of this surplus water in Kootenay lake so that the minimum flow in the winter months may be increased more nearly to the amount required for the said plants, and this is the object sought by the company in its present application.

High Water Flow. "As stated in the application, the average high water flow of Kootenay river is 107,000 c.f.s., but the minimum flow has been as low as 4,800 c.f.s. In the year 1894 Kootenay lake and river were at the highest flood stage that has been recorded. At this time the flow of the river amounted to about 200,000 c.f.s. and the West arm of the lake at Nelson was then at a level of 28·2 above the zero mark on the gauge at the city of Nelson, the said zero mark being at elevation 1739·324, Geodetic Survey of Canada Datum, which would be in the figures of the United States Coast and Geodetic Survey (U.S.C.G.S. 1739·524). The next highest flood peak of the river was in 1903 when the West arm of the lake at Nelson stood 21·6 feet above the Nelson gauge zero mark. At that time 151,000 c.f.s. of water was flowing down the river below Nelson. The average high water level has been through a number of years at about 16 feet above the zero mark of the Nelson gauge, when there would be discharged from the river about 107,000 c.f.s.

Effects of Project. "This company in asking your Honourable Commission for permission to hold the level of Kootenay lake and the West arm at 6 feet above the zero mark on the Nelson gauge for certain months of the year when the water is plentiful, or in other words at elevation 1745·324 G.S.C. datum or 1745·524 U.S.C.G.S. datum, proposes to erect a dam at Granite, three miles below the city of Nelson, and to widen the cross-section of the river at certain points between Grohman creek and a point below the proposed dam, which dam will be of such a flexible character that it will be able to discharge 200,000 c.f.s. if necessary under flood conditions, the lake being still at a lower elevation on the Nelson gauge than it was in the flood peak of 1894.

"According to the figures and curves, plans of which will be submitted to you by our engineer, when the work proposed to be done has been completed, the said

200,000 c.f.s. will be able to discharge itself out of the lake and pass down the river at an elevation of the lake of over 3 feet less on the Nelson gauge than the elevation of the 1894 flood when under natural conditions, the river discharged the 200,000 c.f.s.

"The statement I make there is that at that stage of the level there will be a reduction at our works of over 3 feet, the details of which will be given in our plans and figures.

"A corresponding decrease in the flood peak of the lake in the West arm at Nelson is shown to be possible at all stages of the levels of the West arm from elevation 1745·3 upward. This is made possible of course in consequence of the increase of the cross-sectional areas of the river in the vicinity of Grohman creek and the building of a dam of such character that the increased flow thus made possible will pass into the river below the dam. Similarly the flood levels of the main lake will be decreased at least 3 feet under the conditions of the 1894 flood and a corresponding decrease at all flood stages above the 6 foot storage line. This decrease in the flood stage is of the utmost importance to the reclamation interests in Idaho as it will substantially lessen the hazard they are yearly facing of a flood that will overtop the dikes or break through them at weak points, thus flooding the land at a time when the crops would be destroyed. Too great emphasis cannot be put upon this decreasing of the flood peak and we have no hesitation in stating that it will be a fact. If our storage of water in the fall and winter season should cause a small amount of extra pumping from the drainage ditches, and we do not believe that it will, the benefit to be derived from lowering the flood peak should far outweigh any extra cost of pumping.

Storage Line. "Having established that a benefit rather than an injury must come from our work during the time of high water, I come next to our proposed storage line. Our engineers will file with you charts which show that the lake has fallen to a level of 6 feet above the zero mark on the Nelson gauge on an average some time between the 10th of July and the 20th of August in each year, and that it reaches the 4-foot level above the zero mark between the first week in August and the 10th of September. At the 6-foot level, or elevation 1745·324 G.S.C., there is a flow in the Kootenay River below Nelson of 32,800 c.f.s. At the 4-foot line there is flowing at the same place 21,000 c.f.s. As 10,400 c.f.s. is a desirable flow for our power plants it will be seen that it is possible to allow the lake levels to decrease until the 4 foot mark is reached, and then by closing some of the gates of the dam the level of the lake will be increased to 6 feet above said zero mark on the Nelson gauge, this 6-foot level being attained about the end of September. The flow through the dam will then be regulated to maintain the level of the lake at the 6-foot storage line until the inflow of water into the lake is not sufficient to supply the flow required by our power plants, when the storage will begin to be drawn upon, and the level of the lake thus reduced, giving an even supply of water for the power plants until the time when the water commences to rise again, which varies between the 20th of March and the 10th of April, it being desirable that the storage line be reduced as nearly as possible to the zero mark on the Nelson gauge when the waters commence to rise. As the flood flow then commences the gates will be opened at the dam to allow of the free discharge of the surplus water.

"The water levels in the lake and river in the years 1925 and 1927 during the winter months averaged throughout the whole low water period about 2 feet above the average low water mark and by the 20th of March with the water level standing at over $1\frac{1}{2}$ feet, about the average low water mark, and therefore a river flow of about 10,500 c.f.s., the level started to rise in consequence of the commencement of the spring floods. This condition gave us sufficient water under natural conditions but left more water in the lake at the start of the

flood period than would have been the case had we been operating under the proposed storage scheme when we could have drawn the water level down to the average low water mark and left the lake in a more favourable position for the reception of the flood waters.

" While our application stated that this company desires an average flow of 10,400 c.f.s. it has been found by the further study of the water levels that 6 feet storage in most years will not permit of a steady outflow of 10,400 c.f.s., and our engineer will therefore show you that he has estimated, in order to maintain an even flow until the water commences to rise again, that we will probably have to regulate the flow between 8,700 c.f.s. and 9,500 c.f.s. It would require at least 8 feet of storage to give us the full amount of flow which our power plants require to keep up to capacity.

Effects on Idaho Lands. " The chief objection to our being allowed to maintain the level of Kootenay Lake at the storage line above indicated has come from the owners of the reclaimed lands in the State of Idaho between the international boundary line and Bonners Ferry, these objectors stating that such a level might make it impossible for them to drain their reclaimed lands, to the injury of the soil which they are cultivating. The land in Idaho allegedly affected is land that has been reclaimed from the river by the erection of dirt dikes adjacent to the natural river bank, which dikes prevent the flooding of the land during the flood season, as the level of the water during the flood season is considerably above the level of the land within the dikes. It is timely for me here to state now that this same reclamation of land in Idaho has had considerable to do with the lowering of our minimum flow of Kootenay river below Nelson. Before any of this land was reclaimed there was some 35,000 acres subject to flooding in consequence of which said land acted as a natural reservoir, holding a large quantity of water which would run off during the fall and winter, thus maintaining the minimum flow at a higher level than has been the case since the land has been reclaimed. This seems to me to be an argument that must naturally follow. There has been reclaimed to date, according to the Response filed by the Attorney-General of Idaho, some 23,000 acres and no doubt in time most of the remaining unreclaimed land will be reclaimed in a similar manner. It follows also that this method of reclamation must increase the flood-peak of the lake and river, and thus burden our power plants with an increased flood to take care of.

Jones and Ramser Report. " In corroboration of this statement, the following appears in the report of Messrs L. A. Jones, Senior Drainage Engineer, and C. E. Ramser, Drainage Engineer, prepared under the direction of S. H. McCrory, Chief of Drainage Investigations for the United States Department of Agriculture, this report being made as a result of their investigation of the Idaho Reclamation projects:—

> ' Where a river is so confined between levees, its flood levels are raised and in this case the level of Kootenai lake also would be raised if the capacity of the West arm were not increased. It was estimated that for the 1916 flood the amount of storage water over the river bottoms would have raised the level of the lake about 2 feet if the flood had been confined to the river channel between levees.'

" This means that if the reclamation projects continue on the American and Canadian sides of the line by means of confining the river between levees or dikes without any compensatory work being done to increase the capacity of the West arm to discharge the water, the peak of the flood will be very materially increased. Another feature that is also tending to increase the flood peak and to diminish the low peak is the cutting and burning off of the timber

in the watershed of the Kootenay river. The chance, therefore, of the present power plants of the applicant being flooded in the case of an extreme flood, such as that of 1916 or 1894 becomes a possibility, and in any event it puts upon the applicant the necessity of providing more expensive works to meet this contingency. The Idaho reclaimed land faces the increasing possibility of being flooded for the same reasons. The enlarging of the cross-sectional area at Grohman creek, however, as proposed by the applicant, will tend to mitigate this danger.

"As I have stated above, the level of the water of the lake at Nelson has been above the proposed 6-foot storage line during each of the years 1923 to date, until after the middle of July. Our Exhibit 2, Plan D-16 shows the following dates for the years mentioned when the waters reached the 6-foot line after the flood peak: in 1926, about July 15, although in this year it passed slightly below the 6-ft. line for the last ten days of June, exceeding it again and coming back to the said 6-foot line on July 15; for 1924, on July 20; for 1925, on August 10; for 1923, on August 12; for 1928, on August 15; for 1927, on August 20. In 1927, owing to the heavy precipitation during the last two weeks of September, the level of the lake increased again to over a foot above the 6-foot storage line, passing below the 6-foot storage line again about the 2nd of October.

"As to the 4-foot mark above the zero mark on the Nelson gauge, which is the point to which the lake will be allowed to fall before the levels of the lake are changed, we find that during the same years the levels fell below the 4-foot mark in 1926 about August 4, and during the other years mentioned between September 1 and 15. It appears from this, therefore, that under the proposed storage conditions, since the level of the lake will be allowed to go to the 4-foot mark before allowing the level to build up to the 6-foot mark, up to practically the 1st of September the reclaimed land in Idaho could not possibly be under any worse conditions than have prevailed in the past; and furthermore, at the first of September the crop season is drawing to an end and if such crops were able to grow and mature under the natural conditions, they will continue to have the same opportunity under the proposed storage conditions.

"The 6-foot storage line will not be reached under the new conditions until a date somewhere about the first of October, when even the harvesting of crops must be pretty well completed. By referring to Plan D-4, filed with this Honorable Commission, with the application, it will be seen that at the 6-foot storage level there will be three drainage sluice gates in Idaho somewhat covered with water, one of them, the lowest, being submerged to the extent of some 2½ feet. The remaining drainage sluice gates are all free of water by the time the level reaches the 6-foot storage.

"They have, I understand, some nine districts completed, all having sluice gates, and two under construction. Out of these eleven there are three, as far as we know, submerged, the lowest being the one we observed this morning.

"Because a sluice gate, however, is submerged at the 6-foot level does not mean that the land supporting the crops is not getting adequate drainage. This is owing to the fact that natural conditions have been taken advantage of and the drainage sluice gates placed toward the bottom of a natural slough or creek bed in which the water will lie although the land is being beneficially drained. This must be proved by the fact that throughout practically the whole of the growing season the water under present natural conditions has been at a level above the 6-foot storage line, and if it were a fact that this prevented drainage of the lands adequately, then the crops would not have grown. Finally in the storage period when the water is being drawn from storage in the months of January, February and March, the water will be released from even these low sloughs and the sluice gates will finally be above the level of Kootenay river.

British Columbia Licence. "I should state here that the Provincial Government of British Columbia has granted this company a water storage licence giving the company, so far as the province is concerned, the right to proceed with the works above mentioned and store 6 feet of water in Kootenay lake. I will file certificate from J. C. MacDonald, Comptroller of Water Rights of the province of British Columbia, showing the applicant to be the holder of the water licences on Kootenay river and of the storage licence above referred to.

Navigation. "Kootenay lake and the West arm being navigable water, application has been made to the Department of Public Works, Ottawa, under the Navigable Waters Protection Act of Canada, and the department has indicated its consent to the proposals, subject to conditions which have been accepted by the company, and it is anticipated that already, or if not already in the immediate future, the order will be issued and gazetted.

Power Needs. "Owing to the fact that a customer of the company, the Consolidated Mining and Smelting Company of Canada, Limited, is going to be called upon within the next two years to get into operation a large plant for the manufacture of fertilizer, for the operation of which a large quantity of power will have to be supplied within the next two years, the present applicant finds it necessary to supply such power within the said time and has no means at its disposal to do so except through the additional power that will be obtained from this storage. At the present time during the winter months there is insufficient power for the industries and communities now consuming power, and the Consolidated Mining and Smelting Company, being the chief customer of the applicant, is required to curtail its operations during the said period. With the new fertilizer plant in operation, the situation will be even more acute unless further power can be generated. This additional power required for the fertilizer plants of the Consolidated Mining and Smelting Company being required in consequence of the efforts of the Consolidated to mitigate another international problem, it seems reasonable for me to be asking this Honourable Commission to facilitate as much as possible the final disposition of this matter.

"Owing to the fact that it is impossible to do much of the work in the river bed during the months when the river is in flood, which period extends from on in March to late in July, it is necessary that such work be done during the winter months, and therefore if the present winter months are allowed to pass without this work being commenced, it will mean a delay until the fall and winter of 1930 before work can be commenced, making it impossible to complete the work before it is anticipated the power will be required. The applicant is prepared to commence work on the river immediately the consent of this Honourable Commission is given to do so and will rush the work as fast as possible."

W. J. Tindale. Mr. W. J. Tindale explained that he had been employed with the Ontario Hydro-Electric Power Commission as Engineer in hydraulics from 1914 to 1918; since that time he had been Designing Engineer with the Consolidated Mining and Smelting Company, and the West Kootenay Power and Light Company. He had designed the two latest power plants built by the applicant, one at Lower Bonnington of 60.000 horse-power built in 1924, and the other at South Slocan built in 1927, of 75,000 horse-power. He filed seven plans as Exhibits; explained the method of obtaining data as to the flow of the river by gauge records, and mentioned that the flow at Nelson had exceeded 130,000 c.f.s., based on available records in five years, the highest flow being 200,000 c.f.s. in 1894.

In reply to a question by the chairman as to the effect of digging out and enlarging the outlet upon such extreme floods as in 1894 Mr. Tindale said: "We would discharge more than 200,000 c.f.s. with our gauge at Nelson four feet lower than it would be under present conditions." In reply to a further question he said: "In 1894 the water rose to a height of 28·2 feet above zero at Nelson. Under the new conditions the water would rise to a height of 24·2 feet and we would pass more than 200,000 c.f.s. The lake surface would be four feet lower and we would be passing an equivalent amount of water. . . . We would pass more than 235,000 c.f.s.

Sir William Hearst. "You would pass more than 35,000 c.f.s. in excess of what it would be under natural conditions?"

Mr. Tindale. "Yes."

Mr. Bartlett. "When the spring waters are coming down from the mountains and flooding the land, and there is the greatest danger of water going over the dikes, you figure you could drain down faster by something like 35,000 c.f.s. than under present conditions?"

Mr. Tindale. "Yes, that is perfectly right."

Mr. Bartlett. "And that is the improvement you speak of; that is what you say you are going to do?"

Mr. Tindale. "Yes."

Mr. Bartlett. "You are going to build up a dam to provide storage from which you can draw during dry times and in winter when it will not hurt anybody, and then in the spring when the water rises, you are going to be able to draw it off faster than under normal conditions? Are those the two points?"

Mr. Tindale. "Those are the two points in connection with the dam."

Asked how the company proposed to get this result, he said:

"Our dam is being placed on a rock ledge at Grohman. To pass the maximum flood we placed sills down at the low elevation of 1,726, which is 13 feet below the Nelson gauge zero; that is, practically the low water mark for the Nelson gauge.

"In addition, we provided for nine gates with 50 foot clear span; and we have provided for a spillway 550 feet long, with the sill at elevation 1742·5. Under flood conditions, of course, we would raise our gates when the flood came on, and the water would flow through the gates until it raised to a certain level, 1742·5, and then it would start to flow over the spillways. Our figures for the discharge through the dam show that the water surface of the dam would be lower than it is under present conditions, under all stages of flow, excepting at the very low levels, when there is less than 26,000 cubic feet per second flowing.

"In addition to the work at Granite, in order to obtain a flat hydraulic grade from the dam through to Nelson, we are proposing the excavation of approximately 90,000 cubic yards at Grohman Creek narrows.

Mr. Bartlett. "90,000 cubic yards of stone mostly?"

Mr. Tindale. "It is mostly boulders and gravel. On one side of the river there is a rock ledge which contains about 9,000 cubic yards of rock. That excavation at Grohman Creek narrows is indicated on Exhibit 10. At this point we excavate in the river bed as well as on both sides to lower the sill in the river." . . .

"The net result of these improvements will be a lowering of existing levels at Nelson by slightly more than four feet with 200,000 c.f.s. flow. Four-tenths of one foot of this amount will be lost between Grohman Creek narrows and the main lake, but the net lowering of the main lake effective at Kootenay Landing will be slightly more than 3·6 feet with 200,000 c.f.s. flow."

Effects in Idaho. Asked as to the effect on the river on the Idaho side, Mr. Tindale said: "The effect of this lowering at Kootenay Landing will carry up Kootenay river and have an effect right through as far as Bonners Ferry. It will

be 3·6 feet at Kootenay Landing, but it will gradually decrease as it comes up the valley. The river and the lake will be decreased throughout all stages after the gates are opened in the spring."

Asked as to how much it was proposed to excavate at Granite, where the dam was to be built he said: "In order to provide efficient areas for the water to have flow to the gates, we are excavating 10,000 cubic yards above the dam structure, and to provide efficient areas for discharge after it passes through the gates, we are excavating 120,000 cubic yards.

In the east channel we are excavating 25,000 cubic yards to provide low velocity to the spillway dam, which is indicated across the lower end of the channel.

"In consequence of this excavation, we get free discharge through our dam, and our water slopes are calculated from a point below 700 feet downstream from the sluice gates.

"At any time after August 31, when the lake has fallen to the 4 foot mark on Nelson gauge, the gates would be closed to pass only sufficient water for power purposes, and the surplus would be held back to raise the lake to the storage lines. In 1927 the lake did not fall below the 5 foot mark on Nelson gauge before November 13, and did not reach the 4 foot mark until December 11. Under a similar year, with the same flow as in 1927, on the basis of our method of control, our gates would not be closed for storage until about November 20th. That makes allowance for the increased outflow at Grohman narrows."

River Levels. Mr. Tindale then gave the variation in the flood levels of the river for seven years in the months of June and July. His evidence was to the effect that the proposed works would have done nothing to increase these flood levels but on the contrary would substantially decrease them. After September 1, the water would have a tendency to fall below the four-foot gauge at which stage the amount flowing out of the river with the improvements at Grohman creek, would be 23,600 cubic feet per second, but the company would pass only sufficient for power purposes. It would then store the surplus and raise the lake to the maximum storage line, six feet above the Nelson gauge zero.

Storage. Asked as to what was the end of the storage season, he replied that it would be the time in the spring when the amount of water coming into the lake was greater than the amount required for power, and that would occur between the 20th of March and about the 15th of April.

Asked why he would want to have the water drawn down as low as possible in the lake at the time the freshets started, he said: "We wish to keep it down there in order that there will be no danger; in fact, there is no danger but what we can take care of the rising flood. Just as quickly as the water was more than we needed for power, we would open our gates wide."

Mr. Crowe. "You need water for storage, and at the same time you wish to empty the lake as far as possible so that when the freshet commences there will be storage capacity to lower the flood. Is that right?"

Mr. Tindale. "Yes. On this maximum storage line I intended to get down to the one-foot mark. If the low water season extended to the 10th of April, I would be down to a point not higher than one foot above Nelson gauge zero on the 10th of April. On the 23rd of March, the flow line intersected our maximum flow line. On the basis of this method of control, we would have opened our gates approximately on that date in that year" (1928).

In answer to a question by Mr. McCumber, Mr. Tindale said:—

"The amount of water coming into the lake would be just enough to supply our power demands. The flow coming into the lake is just sufficient to balance our power, and it is at the beginning of the high water raise. As soon as the water shows a tendency to raise higher than our storage line, we open our gates. On May 1st under our storage scheme we have opened our gates wide."

Discussing conditions at the end of the year, and answering a question as to how he knew that late in December he would get enough water coming in to increase the water to the six foot storage line, Mr. Tindale replied; " Based on the level of the four-foot mark at the Nelson gauge, under the existing conditions, the present discharge is 21,000 c.f.s. Under the new conditions the discharge will be 23,600 c.f.s. For power purposes we need only about 11,000 c.f.s., and we still have 12,000 c.f.s. surplus to put into storage. Our calculations show that there will be no trouble in providing that extra two feet on the lake to maintain the storage line."

Protecting Idaho Interests. Mr. Magrath expressed the view that equalization of the stream flow would be beneficial to the Kootenay valley. He added: " The point I want to get at is: to what extent will it be injurious to the people whose interests lie in this valley? I suppose that is the question that we wish to have answered. I am not prepared to say that the advantages will not overbalance the disadvantages; that is the question that the engineers will pass upon. I listened to Mr. Wilson's remarks at the beginning of the hearing and I quite appreciated his concern as representing this community.

" This is the first time the Commission has met down here, and it is perhaps desirable that you should know that in the control of these international waters our duty imposes upon us the obligation to see that all interests are properly protected, and I would like to assure Mr. Wilson and those whom he represents that they need not be alarmed as to what may happen. It is true we permitted the applicants to get their application in without loss of time. In dealing with international projects it is our duty, if we think it desirable, on either side, to facilitate procedure, but in seventeen years' experience on this Commission I have yet to be told that we ever allowed any one interest to take advantage of another. I think it is only fair. I appreciate the concern of Mr. Wilson, but I thought it desirable to make the statement that I have just made.

" The figures and plans that the engineer has just submitted give point to the matter; they imply the ability of these applicants to open up the discharge from the lake and allow the water to be carried down at a greater rate. It will be of advantage on the other side of the line, and I believe it will be an advantage here, because I am satisfied that with these reclamation projects here flood conditions are things you do not like. But I would like to find out to what extent this project is likely to injure the investments that have been made along this river in Idaho."

Mr. Tindale in reply quoted the following from his Statement: (Appendix K).

" The following data pertains to sluices and lands in reclamation districts in Idaho, U.S.A. The distances given are based on calculated length of the West arm of Kootenay lake, the main lake and the winding river channel above Kootenay lake. No. 8 sluice. . ."

" Mr. Crowe. Explain what that is."

" Mr. Tindale. No. 8 sluice is the sluice draining District No. 8. No. 8 sluice is 78 miles from Nelson, B.C., and the invert elevation is 1744·82. Our maximum storage at that point is shown on drawing D-4; 1746·07 would be our storage line at that sluice."

" Mr. Crowe. How much is the invert elevation of the sluice below or above the storage line?"

" Mr. Tindale. The invert elevation is 1744·82; that would be 1·25 feet higher than the bottom of the sluice. No. 6 sluice is 85 miles from Nelson and the invert elevation is 1742·76."

" Mr. Crowe. Is No. 6 sluice to be submerged by our storage elevation?"

" Mr. Tindale. No. 6 would be below our maximum storage line."

" Mr. Crowe. How much?"

"Mr. Tindale. Our maximum storage line would be 3·4 feet above the lowest point of the sluice."

"Mr. Bartlett. You call sluices those ditches which run into the river?"

"Mr. Tindale. They are the ditches that drain the reclamation area."

"Mr. Bartlett. We saw one where there was a pumping station."

"Mr. Tindale. Yes."

"Mr. Bartlett. If the water were maintained at your storage line, that is if the dam raised the water six feet and it was held just even with the dam, would that water back into these ditches?"

"Mr. Tindale. Yes, at the maximum storage the water would back through the sluices into the ditches."

"Mr. Bartlett. How deep?"

"Mr. Tindale. At No. 6 about three and a half feet of water at the maximum storage line."

"Mr. Bartlett. Your scheme does not contemplate that would be so except in the fall and winter months?"

"Mr. Tindale. On the basis of the storage line shown on Exhibit No. 8, according to my calculations, No. 6 sluice would be above the water surface on February 1st."

"Mr. Bartlett. Would the water back into No. 6 sluice?"

"Mr. Tindale. Yes, considering the sloping surface of our storage line."

"Mr. Crowe. When would it first be submerged by our storage line?"

"Mr. Tindale. Normally it would be partially submerged when we started to store water at the four-foot mark."

"Mr. Crowe. I am talking about the water backing into the ditch. At what mark would it be when there would be a little water in the bottom of the ditch?

"Mr. Tindale. On December 1st, 1928, the flow at Nelson was 9,300 cubic second feet and water elevations based on gauge readings were as follows: Nelson, 1740·52; Porthill, 1741·31; Copeland, 1741·44; and Bonners Ferry 1742·88. The hydraulic grade from Nelson to No. 8 sluice at Porthill was 0·79 feet, and from Nelson to No. 6 sluice was 0·76 feet, and from Nelson to No. 1 sluice, 2·16. Our calculations indicate that hydraulic grades will be less than above under storage conditions due to the larger cross-sectional area of the river. If we use the above hydraulic grades, however, water will be below No. 8 sluice with water at Nelson gauge at elevation 1744·03; below No. 6 sluice with Nelson gauge elevation 1741·90 and No. 1 sluice with Nelson gauge elevation 1742·78. Considering the highest flow line on drawing D-16, No. 8 sluice will be above the water surface on February 1; No. 6 sluice on March 9, and No. 1 sluice on February 23. Those are the dates I have calculated."

Mr. Tindale explained that the sluices or outlets of drainage districts 8, 6 and 1 were below the company's proposed six-foot storage line. The remainder of the sluices were all well above it. Consequently the storage scheme would not affect drainage under present conditions.

Asked if in his opinion there would be adequate drainage for Districts 1, 6 and 8 under his scheme, he said: "As far as I can calculate there would be sufficient time at the storage season for adequate drainage. While No. 6 would be submerged lower than others, it is placed in a low ditch to take advantage of an existing channel."

"Mr. Crowe. So that even were water backed into it as a consequence of our work, there would still be ample drainage for the land?"

"Mr. Tindale. Yes, considering that the land is all 4·37 (feet) above our highest storage line."

"Mr. Crowe. Is it a fact that throughout practically the whole of the growing period the water is very much higher under the natural conditions prevailing than under our proposed storage conditions."

"Mr. Tindale. During the crop-growing period normally the water is various distances above our storage line, excepting for a short period during the early part of April."

"Mr. Bartlett. How far would it be from your storage line to the top of the dike at the lowest point?"

"Mr. Tindale. No. 9 dike is 22 feet above the highest storage line."

"Mr. Bartlett. Is that the dike you would fear the most in a flood?"

"Mr. Tindale. No. 9 is the lowest dike."

"Mr. Bartlett. That is the one you would fear breaking through in case of a flood?"

"Mr. Tindale. Yes, I think No. 9 would be the one most affected by floods. It is about 18 miles this side of the international boundary."

"Mr. Bartlett. If you raise the water six feet, if you do not do anything more than that, and if nature does not intervene in any other way, you will still be how many feet below the top of the dike?"

"Mr. Tindale. Twenty-two feet."

"Mr. Bartlett. If there was not any dike there, and if nature was not operating in any other way, is your storage line up to the level of the farming land?"

"Mr. Tindale. That would refer to the top of the normal land along the river?"

"Mr. Bartlett. Yes."

"Mr. Tindale. It is quite a few feet above the highest storage line."

"Mr. Bartlett. The lowest point?"

"Mr. Tindale. Yes" . . . .

"Mr. Bartlett. Going back from the river and taking perhaps the lowest level you could find, would there be any level as low as your storage line?"

"Mr. Tindale. No, my figures for the lowest land are based on the lowest I could find in any of the reclamation districts."

Silting. Mr. Tindale made the following statement in regard to silting in the river: "Our studies indicate that very little if any silt is carried down the river during the low water period, but that a considerable amount is carried down during the flood season. Dredging of this deposited material is necessary at Kootenay Landing at intervals in the interests of navigation. The increased velocity of flow, due to the lower water surface of the river, will have the effect of carrying silt farther into the lake and will be of some benefit in keeping the river channel open.

"The work which we propose in connection with the dam construction will not interfere with any future schemes which might have as their object further lowering of the lake in the interests of reclamation. We have endeavoured to design a structure which if built will be simple and efficient for the control of storage and which will benefit navigation and impose no hardship on reclamation. Our proposed works will maintain low water slightly above present level and will lower flood levels on the lake and in the river above Kootenay Landing. This in case of an extreme flood would be of distinct benefit to reclamation and navigation interests."

Questioned by Mr. Gillis as to the relative value to the Idaho settlers of the excavation at Grohman naarrows or at Proctor, Mr. Tindale said: "Our calculations indicate that the most economical point with regard to lake lowering is at Grohman creek on account of the hydraulic grade at this point due to the high water surfaces."

"Mr. Gillis. Is there not some retarding of the flood water at Proctor narrows?"

"Mr. Tindale. From my calculations of this work, any work done at Proctor narrows would have the effect of flattening out the present grade. Grohman is the principal point responsible for high water levels of the lake. This is the first point at which to start work to get the most benefit."

Lorne A. Campbell. The General Manager of the West Kootenay Power and Light Company, drew the attention of the Commission to a report made by Lewis A. Jones and C. E. Ramser to the United States Department of Agriculture in 1917. "At that time," he said, "they figured out that the only way the lands on this (United States) side of the international boundary could be reclaimed was by opening up the second control point on the Kootenay river at the place known as Granite. We propose to excavate at Granite both on the approach side of the dam and the discharge side of the dam, and in the east channel some 100,000 yards of rock. This excavation is necessary in order to make provision for control during the high water stage. When this work is completed, we propose to move up to Grohman creek and excavate a certain yardage there in order to bring the control up to a certain point and to work in with our proposed storage scheme."

Previous Investigations. Mr. Campbell also referred to the report of W. G. Sloan and said:—

"This report follows much the same lines as the other. These two reports should be taken together. If you wish to bring about a safe reclamation, a reclamation that can be carried out on practical lines and one that will allow the rancher to go in and build his house and to dike without fear of the dike being over-topped, you will find a plan outlined in these two reports designed to bring about such a result, and, by comparing the statements and recommendations in these reports with our proposals, you will also find that we are going a long way towards realizing the original ideas of these engineers."

Mr. Campbell also referred to a report by Meurling to the Government of British Columbia in 1913. "He made a complete examination of the question (reclamation of Kootenay flats) and his report was very much on the lines of these two that I have just referred to. . . .

"The British Columbia Government was approached upon the question as to whether some scheme could be figured out between them and the Government at Washington by which both Governments would share the expense of opening up the Narrows at Grohman creek and constructing the dam at Granite."

"We are willing to go ahead at our own expense and carry out this enormous undertaking. I do not mind telling you what the possible expenditure upon this work will be. Taking into consideration the rock excavation at Granite, the yardage of rock which it will be necessary to excavate on the south bank of the river at Grohman creek, the yardage of soft boulder and gravel on the north bank, and the equipment it will be necessary to purchase, including a dredge with a four-yard dipper and an arm making it available for use as a sand-sucker at any point where such dredging may be necessary, we expect to expend, according to our estimate for the job, $1,500,000. If, a few years ago, we had taken up the question purely from the reclamation service standpoint—and I feel confident that an arrangement could have been arrived at between the British Columbia Government and the Government at Washington—the probabilities are that this very thing that we now propose to undertake would have been accomplished, and we would not have been called upon to bear the total cost ourselves. I believe enormous benefits will result from the work which we propose to carry out."

Victor H. Greisser. The Chief Engineer of the Washington Water Power Company, of Spokane, explained the interest of the people he represented in the applicant's project: He said:—

"We are interested, of course, in any augmentation of the low water flow of the Columbia river. The economic development of any water power site depends very largely on the low water flow. Most power companies, in fact all of them, must sell their power or be ready to sell their power at any minute of the year and not just when the water is high on one certain river, or on some

group of rivers, but throughout the year; and, while there is some seasonal variation in demand of power throughout the year, nevertheless the economic development must in the end largely depend on the quantity of water available during the low water season. It has, in fact, become a rather questionable thing, in a great many instances of proposed development of power sites that they were not economic developments because of the extreme range of flow of water from the high water period to the low water period. Practically all power sites along the Pacific slope west of the Rocky mountains are located on rivers where there is a very rapid run-off of the flood waters and a reduction to a very low minimum flow. I would say that this low minimum flow makes it difficult to-day in a great many instances to get economic development, so that anything that will increase that low water flow is a direct asset to the community.

"In view of that fact, this proposed improvement or storage of water on Kootenay lake will have a direct effect not only upon Kettle falls in raising its power capacity, but upon all other power plants which may in the course of time be developed along the Columbia river."

L. R. Coffin. The Manager of the Eastern District Puget Sound Power and Light Company confirmed in substance Mr. Greisser's testimony. "I think it is obvious," he said, "that any control of waters in a stream of that kind (the Kootenay) would be of tremendous benefit to the whole State of Washington."

Canadian Government. Mr. J. T. Johnston, appearing on behalf of the Department of the Interior and the Department of Indian Affairs of Canada, said that the technical officers of both Governments had been collecting physical data respecting the Kootenay river, which was being exchanged and which put them in a position to analyse independently the problems involved in the application. "My own view," he said, "is that this problem will only be settled on the basis of the facts as to whether or not and to what extent the high water conditions are benefited by the works proposed to be constructed by the company, and to what extent if any the waters are backed up in the low water season. I think that these facts can be best established by the engineers. . . . . . .

"We have made a very careful analysis of the company's proposals. The company claim that they will benefit the flow past the dam site; in other words, that they will increase the discharge past that point. Our independent studies confirm that. We have adopted the most conservative co-efficients and recognized engineering formulas and, as I say, our figures confirm the company's claim. We have turned these figures over to the United States Geological Survey officers and they undoubtedly will make their own independent studies of the same situation.

"The company also claim that in times of high water the execution of their project will be a benefit to the high water conditions. Our studies also confirm that statement. . . . . The tentative analysis that we have completed does at least show that in times of high water there will be a very substantial lowering of the water level in Kootenay lake, and our figures also indicate that there will be an even greater lowering than the company has indicated to the Commission. . . . . We have looked into the admission that the company has made that there will be a certain backing up in times of high water. . . . .

"I do not want to quote these figures as being final, but the figures that we arrived at show that at the international boundary, up to the month of September, there would be no back water effect. In the month of September, the average increase in the stored water over and above what it would be under natural conditions was 1·21 feet. In October, the average back-up was 2·30 feet; in November, 2·8 feet; in December, 3·51 feet; in January, 3·39 feet; in February, 2·2 feet; and in March, 0·82 feet. These figures represent our conclusions up to date."

Mr. Johnston informed the Commission that the Department of Indian Affairs of Canada had authorized him to say to the Commission that the department had "accepted our figures as to the effects and that it does not feel that the backing up at low water will be detrimental to its reserves. On the other hand, the officials were highly appreciative of the beneficial results that would accrue at the high water stage. They did ask that should anything unanticipated result, they might receive protection in the final order."

"Mr. Bartlett. Is that your own judgment?"

"Mr. Johnston. Yes, that is my own judgment."

"Mr. Bartlett. From all your studies do you think they are safe up there with their farming?"

"Mr. Johnston. I think so. We gave them our figures and our figures indicate a betterment that under high water conditions far exceeds the detriment or damage they may possibly suffer by moderate backing-up of the water."

"Mr. Bartlett. On your professional reputation as an official of the Dominion of Canada, you express the opinion that these Indians who are wards of your country, will not be injured by this proposal?"

"Mr. Johnston. Yes."

"Mr. Bartlett. Would they be injured as naturally and as quickly as the Idaho people?"

"Mr. Johnston. From their location farther down they would be subject to greater backing up than would take place on this side of the line (United States) because there is a flattening out as you go higher up the river."

E. Davis. Mr. E. Davis, speaking on behalf of the Comptroller of Water Rights of British Columbia, said: "In considering the application, the possible effect on the lands owned by the province of British Columbia, was given attention to, and the conclusion arrived at was that any work or storage proposition which would increase the discharge and improve the high water conditions could have no detrimental effect and on these grounds a licence was issued to store water in the lake (Kootenay)."

O. C. Wilson. Mr. O. C. Wilson, Counsel for the Reclamation Districts in Idaho, referred to the unusual slope of the land in the Kootenay Valley in Idaho. "The ordinary idea," he said, "would be that the land would slope from the river directly to the hillside. That condition does not exist in this valley; in fact, it is directly the opposite and with the condition accentuated at the river bank. Our river banks reach the highest point of our valley; in fact we have some places where we have a pronounced hill right at the river banks and then the slope is directly back from that point, following a downward grade to the hillside, with the result that our lowest land is closest to the hillside and our highest land at the river bank. Naturally, that produces a fixed condition which we attempt to get around in our drainage projects.

"A great deal of the evidence—in fact I might say all of the evidence—which has been produced by the West Kootenay Power and Light Company has been to the effect that our projects would be benefited by their proposed improvements, owing to the fact that they would relieve the peak load at the highest situation. We wish very emphatically to bring to the attention of the Commission the fact that our projects were constructed for the purpose of protecting our land from the high water condition, and that we have already constructed our districts and protected our land against that condition. If arrangements could have been made to take care of the peak load before we constructed our districts, we would not have constructed our dikes to the elevation we have.

Idaho Dikes. "We have constructed all our dikes, with the exception of one district, to protect our lands against the highest condition which existed in 1894 of which, by the way, we have no actual record but which has been com-

puted. Our dikes have been constructed for the purpose of protecting our land against that condition. Therefore, any benefit which is suggested by the Power Company as having been conferred upon these districts is one in mind only; it is not something which benefits us because our work is already done, our expenditures made, and we have protected most of these districts. The most that can be said is that it may be lending an element of safety to our districts; that is all.

Damage to Land. " That being the case, the question which comes to us is one of the damage to our land which is serious during low water conditions. Our soil is very spongy soil; I may use that expression as conveying the idea that the soil will hold water as a sponge does. When the water gets in there, it takes a great deal of time to get it out. We constructed our drainage ditches and found when we had completed our construction as planned by the engineers that we did not have adequate interior drainage, simply because with soil of that kind we could not entirely get the water out. We also found that the river channel itself was one of our biggest aids in getting rid of that water; that the water went out of the districts at the low water stage through that river channel. It also went out by what we call our lateral ditches.

Interior Drain Ditches. " Then we were required to put in interior drain ditches leading to the main drain laterals to take the water out. Whenever the water gets into that land it cannot be taken out in a short time. Our engineers advise us that it will be very difficult to say that the water could be pumped out. We also have channels, or strata, through the soil running from the river bank where the water comes in. I believe you gentlemen examined some of our dikes and you noticed a borrow pit on the inside of the dike; in other words, that part where the dirt was taken to construct the dike, leaving the ditch or borrow pit.

" We have observed that when the water goes up to an elevation equal to the banks of this borrow pit it will seep through by way of the strata and the soil and will flow into the borrow pit. That water does not go through on a sloping grade to the bottom of the borrow pit, but goes through the channel or straight through to the bottom of the borrow pit. We find that that condition exists entirely through our soil, that when the level of the river rises the water table in our land rises with it practically on an even grade.

Effect of Low Water. " Evidence was introduced, but I may say at this point that I thought it was plainly apparent that the Power Company had made no investigation whatsoever of this valley as to the effect of low-water conditions; they offered nothing and had nothing upon which we could base any conclusions. I would call your attention to the fact that the United States Geological Survey Report, which is filed with you, contains in the appendix, the elevations, and that there is such a great disparity between the figures presented by the company and the United States Geological Survey that you will readily see the point we are making.

" Our serious situation comes from the low water stage, and it is going to be seriously increased by the raising of the low water level by this extra six feet. If that is done we will not have a point in our low lands where the water table will be four or six feet below the level of the water in the river; in other words, that low water stage will not be four feet below the level of our lands. We will show you clearly that the average will be much higher than that. Our evidence will show that we cannot have satisfactory agricultural conditions here unless we can get the water table at least four feet below the surface of the soil. We have proved by actual experimental work in this valley that wherever the water table comes up to two feet from the top we have considerable trouble.

In reply to a question by Mr. McCumber as to the effect of raising the water table within two feet of the surface of the land, Mr. Wilson said: "The land can be farmed, but you do not get the benefit of your soil. The land underneath is water-logged; that soil has too much moisture, and with our water-table kept in by the river and raised it makes a saturated solution of the soil which prevents successful farming. I do not mean to say that you cannot raise a crop, but you will find that where the water table gets close to the surface so they can farm it at all, the lowest land produces the poorest crops, and the difference is so great as to be noticeable."

"Mr. McCumber. You always raise some crop but not nearly as good a crop?"

"Mr. Wilson. That is correct."

"Mr. McCumber. Where would you place the line at which it would not affect your crop disastrously?"

"Mr. Wilson. Four feet."

"Mr. McCumber. You think if it is kept below four feet it would not seriously interfere with your crops?"

"Mr. Wilson. That is our impression from the evidence we have."

At a somewhat later stage Mr. McCumber asked to what extent the sluices would assist during the dry season, or the low water season, in taking care of water that was already on the land and which it was desired to get rid of. Mr. Wilson replied: "You realize that our interior drainage, which you call the sluices, is designed primarily for collecting the water from the water-sheds up in the hills and from the surface water which is precipitated upon our lands. Of course they take care, to a certain extent, of a great deal of the water that comes in by seepage, but the depth of the river is so great that it acts as a much better drainage channel to draw off that water than our ditches which stand up high. In other words, that river is in places 90 feet deep, and you have a ditch there that can draw that water out."

W. D. Gillis. Mr. Gillis supplemented the statement made by Mr. Wilson, and said that they would expect at a later hearing to put before the Commission figures which they believed would show clearly and conclusively serious damage to the citzens of Idaho in Kootenay valley arising out of the proposed works. This damage would result from the necessity of providing additional sluicing to take care of the raise of 6 feet over normal low water. "It has been stated to us that that possibility may in some of the districts require an additional expenditure by the settlers of approximately $10 per acre. . . . The evidence that we now possess indicates that within the two-foot level, that is that this raising of the six-foot normal storage will raise this water level to within two feet of the surface of the ground in approximately a thousand acres, in exact figures 990 acres; that it will raise it to within four feet of the surface in 3,135 acres; within six feet in 7,865 acres; within eight feet in 11,405 acres, or for more than half of the land now in cultivation or under these districts, assuming that there is a possibility that the eight-foot level is the basis of the lowest figure. Mr. Wilson has suggested that four feet is the danger mark. The United States Geological Survey has suggested that eight feet was probably the safe basis. So that nearly one-half of this area is likely to be, and in all probability would be, affected by the raising of this water level."

Mr. Gillis pointed out that very considerable expense and damage would also be involved by reason of additional hours and days of pumping because of the outlet being flooded, and gravity escape of the water would not be possible.

United States Geological Survey. In the Statement filed on behalf of the United States Geological Survey (Appendix I) reference is made to the applicant's claim that "the proposed works will not have any injurious effect on any

interests in the United States or any state thereof." It is the opinion of the Geological Survey that the application contains no information adequately supporting these allegations. "It is true that the plan of the application to hold the lake at a stage of 6 feet seems relatively modest when considered in relation to flood heights that have caused injury in Kootenai Valley—that is, stages of 16 or 18 feet or more. Nevertheless, the effect of the proposed modification of lake levels upon the operation and maintenance of drainage districts in Idaho, contrary to the allegation of the company, would apparently be materially injurious.

"Drainage is usually accomplished by promoting the movement of ground waters to lower levels and drainage ditches are constructed to conduct the surplus waters from wet lands to lower outlets or to pumps. Because of the relatively narrow valley through which it flows, the Kootenai river has in the past served very effectively through the long low-water season, in draining the flat marshy lands above Kootenai lake. The injury under the proposed modification would arise from the fact that in the last of the summer, when the river would naturally continue falling more or less uniformly until diked lands could be drained into it without pumping, the water level instead would be maintained at the 6-foot stage, actually covering some of the drainage outlets and generally making the drainage of the reclaimed lands into the river more difficult and expensive. This condition would continue in a greater or less degree through the late summer, the autumn, and the first part of the winter, the extent of drawdown of the stored water depending on whether the natural supply was scanty or plentiful. The discharge of the river does not always continue falling uniformly but is sometimes increased by autumn storms.

The statement adds: "In the opinion of the Geological Survey the proposed works and their operation would increase the water-logging of the diked lands and would place upon the owners an additional burden incident to contending with this condition. The burden would generally consist in the operation of the pumping plants through longer periods or at increased capacities, and in the extension of the systems of interior drainage ditches."

Discussing safeguards in the event of the application being approved, the statement of the Geological Survey says: "Property holders and residents of the United States affected have good reason to require that if the proposed dam is constructed and operated, there shall exist no possibility that it will be operated otherwise than as contemplated in the application. It is believed that an effective means for affording assurance to citizens of the United States in this regard would be to provide for direct supervision and control of the operation of the dam by an International Board agreed upon by the two countries."

Replying to a question by Mr. McCumber as to whether or not with water seeping away and remaining longer in the land, it would leave an injurious mineral deposit, Mr. Wilson replied: "It does not. Our agricultural conditions are, you may say, in the experimental stage at the present time. Our people were poor, they went on this land without adequate farming equipment or capital. They have developed wheat farming, that being a quick crop and not difficult to produce, but we know from experiments conducted by the state university and by the Government that it is only a question of a few years before this land, if it is not interfered with and if the conditions which we have now remain, will be developed further. We believe that this land will be producing crops which will bring from $250 to $500 an acre in return. It will not be wheat land; we know it is not that; the soil is too rich for that."

C. G. Paulsen. The District Engineer of the United States Geological Survey explained to the Commission why in his opinion it was necessary to have a year's time in which to make a detailed investigation of the ground water in the drainage districts.

R. C. Crowe. Mr. Crowe, on behalf of the applicants, requested permission to go ahead with excavation in the dry rock above and below the site of the dam at Granite, on the distinct understanding that the work would be done entirely at the applicant's risk and irrespective of what the order of the Commission might ultimately be.

Attorney General of Idaho. The Chairman asked the Attorney-General of Idaho if he saw any objection to Mr. Crowe's request. Mr. Gillis replied: "I feel that we could not object under the conditions that the honourable counsel suggests. We do not want to obstruct any work of that character.... My understanding is that it is entirely without prejudice to the final decision of this Commission."

"Mr. Crowe. That is my statement and understanding, that it is entirely without prejudice and entirely at our risk, and we are not going to interfere with the control of the lake in doing it."

Order re Adjournment. The Commission having gone into executive session, the hearing was reconvened and the Chairman made the following statement in regard to the request on behalf of the State of Idaho for a year's adjournment:—

"The Commission does not feel that it would be wise to set a date with absolute certainty as to when we can meet again or finish our case. We hardly think it would be wise to set a year, and we do not think it would be wise, perhaps, to set three weeks; but our frame of mind is that the engineers and experts on seepage, or whatever they are, should get together in good faith and work for a little while. The Canadian Chairman and I will keep in touch with the situation, and, as soon as we think the thing has matured to a point where we can have another meeting properly and fairly for everybody, we will try to set a date and let you know."

Exhibits. A list of the Exhibits filed in this case at the above hearing on behalf of the Government of Canada, the Government of the United States, the State of Idaho, and the West Kootenay Power and Light Co. Limited, will be found in Appendix N.

Interim Report on Ground Water Studies of United States Geological Survey. On April 4, 1931, Dr. W. C. Mendenhall, the Acting Director of the United States Geological Survey, filed with the Commission the following interim report:—

"Following is a brief interim report with respect to the activities of the United States Geological Survey in relation to the Application of the West Kootenay Power and Light Company, Limited, to construct a storage dam on Kootenay river in the vicinity of Granite, B.C., which is now pending before your Commission.

"Analytical studies have been made of the effects of the proposed dam in the modification of the water levels in the lake and river above. Certain features of the project have been changed since the presentation of the original application. It would be desirable, from the standpoint of more definite understanding, if a formal detailed statement of the present plan of operation were available. For these reasons and because the changes in the plans for the project since the presentation of the original formal application are quite material, it is suggested that it would contribute to more convenient and orderly consideration of the application if the West Kootenay Power and Light Company, Limited, would submit in formal manner a complete amended application covering the project and details of operation as now planned.

"The foregoing statement relates to the application of the West Kootenay Power and Light Company, Limited, to construct a dam at the Granite site.

Reliable information has been received during the past few months that the power company is considering a scheme of development involving the construction of a dam at the Corra Linn site, so-called, on Kootenai river, located about four miles below the Granite site, which may have the effect of eliminating the need for a dam at Granite. A change to the Corra Linn site would undoubtedly introduce a set of hydraulic conditions quite different from those contemplated in connection with the Granite development. Consequently, and in conformity with informal suggestion from reliable Canadian sources, the analysis of hydraulic conditions in the lake and river pertinent to the Granite dam and the proposed work at Grohman narrows has been suspended until the indicated uncertainties have been removed.

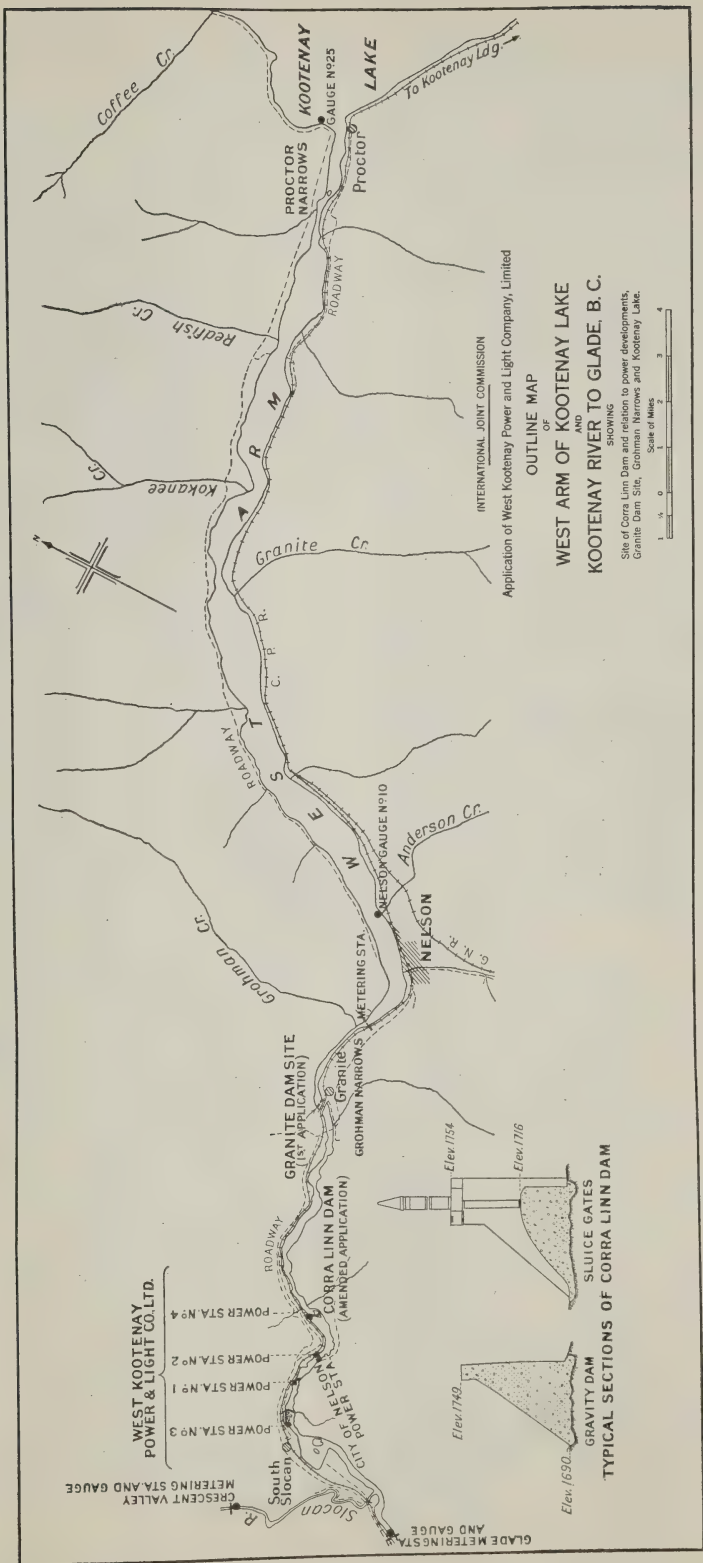
"At the hearing of the International Joint Commission at Bonners Ferry, Idaho, on November 6, 1929, the need for studies of ground-water conditions in the Kootenai flats in Idaho became apparent. Extensive investigation of this subject was immediately undertaken by the United States Geological Survey. The State of Idaho and the West Kootenay Power and Light Company, Limited, participated in the financing of the initial stage of the investigation in order to get it under way as rapidly as possible. Three hundred wells have been drilled in the bottom lands of the valley and observations of ground-water levels have been made. Intensive study has been made of these data and of many other data pertinent to the problem.

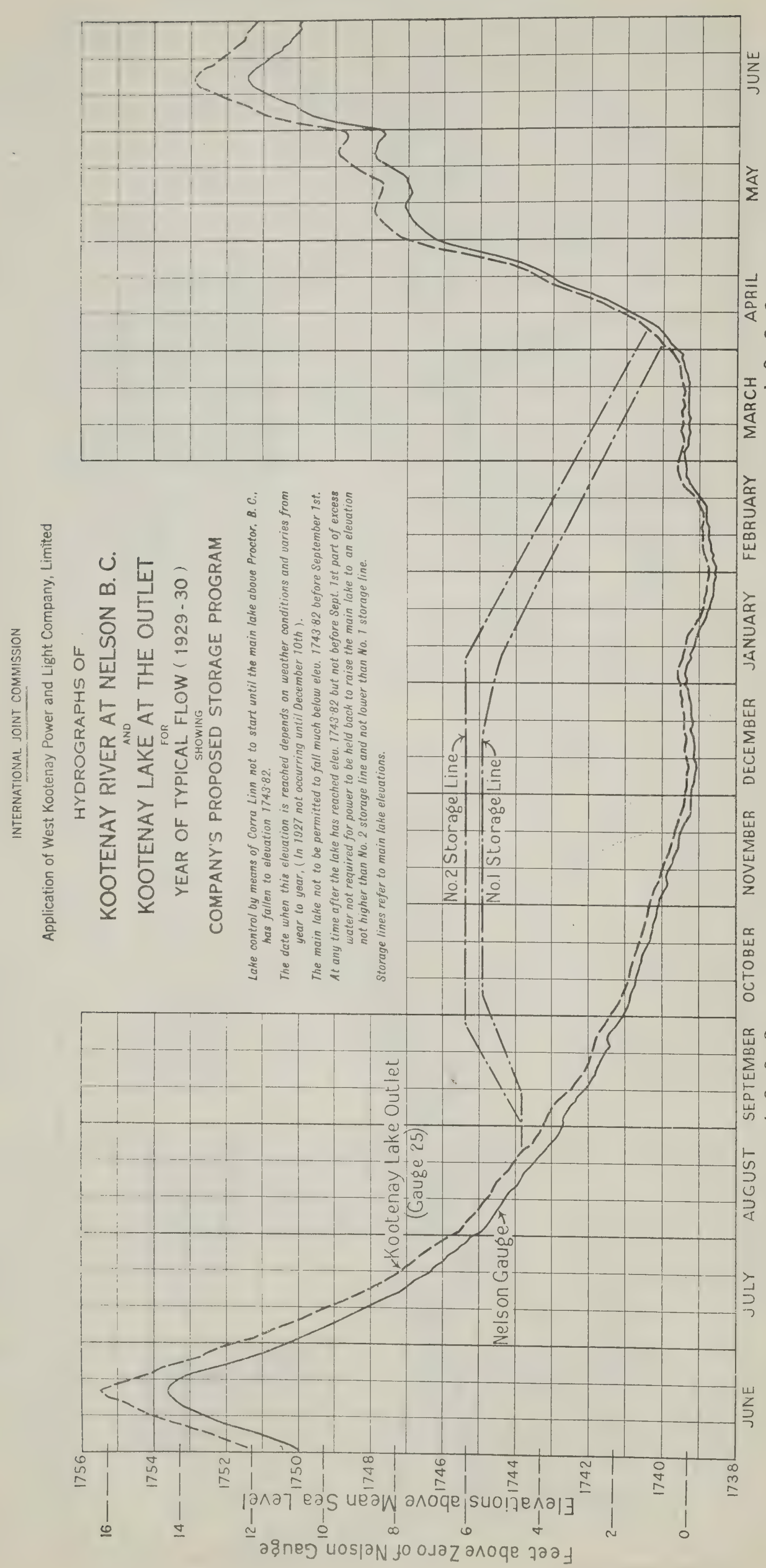
"The need for expert consideration of agricultural aspects of the problem led to the participation and co-operation in the investigation of the Division of Agricultural Engineering, Bureau of Public Roads, United States Department of Agriculture. That organization has been quite active and has collected many data.

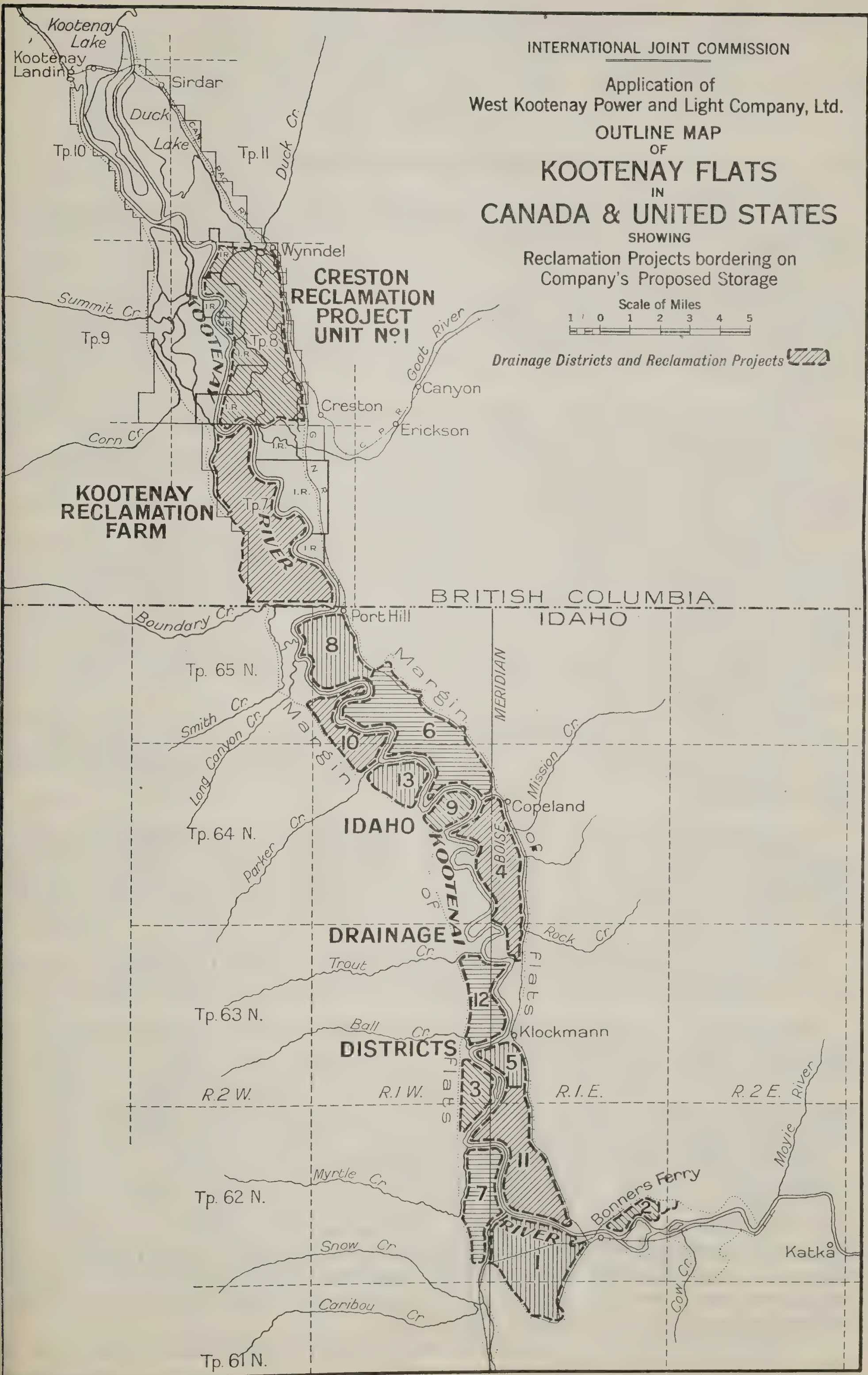
"Excellent progress has been made in the development of information concerning the behavior of ground water in Kootenai valley. However, the problem is complex and further observation of certain factors is found to be quite desirable and even necessary. Consequently, plans are being made for the continuation of the present intensive observation and study through the coming summer and fall. Further opportunity for the observation of flood conditions in Kootenai valley is very desirable. Therefore, from the standpoint of the successful consummation of this investigation as it relates to the pending application of the West Kootenay Power and Light Company, Limited, and especially in view of the apparent uncertainty regarding the proposed plans for the construction of the Granite dam, it is suggested that a course be followed consistent with withholding any action which would require the utilization of results of this investigation until they have been adequately developed and organized for presentation."

Supplemental Response on behalf of the State of Idaho and Drainage Districts 1-13. On January 23, 1932, the Attorney-General of Idaho and the Solicitor representing the Drainage Districts 1 to 13, filed with the Commission a formal Statement in Response to the Application of the West Kootenay Power and Light Company for permission to construct and operate certain permanent works in and adjacent to the channel of the Kootenay river, for storage purposes, at Granite, British Columbia. (Appendix L.)

Reply on behalf of Applicant to Supplemental Response of State of Idaho, etc. On February 29, 1932, counsel on behalf on the applicant filed with the Commission the Reply of West Kootenay Power and Light Company, Limited, to the Supplemental Response of the State of Idaho and Drainage Districts Numbers 1 to 13 of the County of Boundary. (Appendix M.)


INTERNATIONAL JOINT COMMISSION
Application of West Kootenay Power and Light Company, Limited
OUTLINE MAP
OF
WEST ARM OF KOOTENAY LAKE
AND
KOOTENAY RIVER TO GLADE, B. C.
SHOWING
Site of Corra Linn Dam and relation to power developments, Granite Dam Site, Grohman Narrows and Kootenay Lake.
Scale of Miles
KOOTENAY
LAKE
GAUGE Nº 25
PROCTOR NARROWS
Proctor
To Kootenay Ldg.
Coffee Cr.
Redfish Cr.
Kokanee Cr.
Granite Cr.
Anderson Cr.
Grohman Cr.
WEST ARM
ROADWAY
C. P. R.
G. N. R.
NELSON
NELSON GAUGE Nº 10
METERING STA.
GROHMAN NARROWS
Granite
GRANITE DAM SITE
(1ST APPLICATION)
CORRA LINN DAM
(AMENDED APPLICATION)
WEST KOOTENAY POWER & LIGHT CO. LTD.
POWER STA. Nº 4
POWER STA. Nº 2
POWER STA. Nº 1
POWER STA. Nº 3
CITY OF NELSON POWER STA.
South Slocan
Slocan R.
CRESCENT VALLEY METERING STA. AND GAUGE
GLADE METERING STA. AND GAUGE
Elev. 1754
Elev. 1716
SLUICE GATES
Elev. 1749
Elev. 1690
GRAVITY DAM
TYPICAL SECTIONS OF CORRA LINN DAM


INTERNATIONAL JOINT COMMISSION
Application of West Kootenay Power and Light Company, Limited
HYDROGRAPHS OF
KOOTENAY RIVER AT NELSON B. C.
AND
KOOTENAY LAKE AT THE OUTLET
FOR
YEAR OF TYPICAL FLOW (1929 - 30)
SHOWING
COMPANY'S PROPOSED STORAGE PROGRAM
Lake control by means of Corra Linn not to start until the main lake above Proctor, B. C., has fallen to elevation 1743·82.
The date when this elevation is reached depends on weather conditions and varies from year to year, (In 1927 not occurring until December 10th).
The main lake not to be permitted to fall much below elev. 1743·82 before September 1st.
At any time after the lake has reached elev. 1743·82 but not before Sept. 1st part of excess water not required for power to be held back to raise the main lake to an elevation not higher than No. 2 storage line and not lower than No. 1 storage line.
Storage lines refer to main lake elevations.
No.2 Storage Line
No.1 Storage Line
Kootenay Lake Outlet (Gauge 25)
Nelson Gauge
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
1 9 2 9
1 9 3 0
1756
1754
1752
1750
1748
1746
1744
1742
1740
1738
16
14
12
10
8
6
4
2
0
Elevations above Mean Sea Level
Feet above Zero of Nelson Gauge



INTERNATIONAL JOINT COMMISSION
Application of
West Kootenay Power and Light Company, Ltd.
OUTLINE MAP
OF
KOOTENAY FLATS
IN
CANADA & UNITED STATES
SHOWING
Reclamation Projects bordering on
Company's Proposed Storage
Scale of Miles
1 0 1 2 3 4 5
Drainage Districts and Reclamation Projects
Kootenay Lake
Kootenay Landing
Sirdar
Duck Lake
Duck Cr.
Tp.10
Tp.11
Wynndel
CRESTON RECLAMATION PROJECT UNIT No. 1
Summit Cr.
Tp.9
Tp.8
Goat River
Canyon
Creston
Erickson
Corn Cr.
KOOTENAY RECLAMATION FARM
Tp.7
KOOTENAY RIVER
BRITISH COLUMBIA
IDAHO
Boundary Cr.
Port Hill
Tp. 65 N.
Margin
MERIDIAN
Smith Cr.
Long Canyon Cr.
Mission Cr.
Copeland
Tp. 64 N.
Parker Cr.
IDAHO
BOISE
KOOTENAI
DRAINAGE
Rock Cr.
Trout Cr.
Flats
Tp. 63 N.
Ball Cr.
Klockmann
DISTRICTS
R.2 W.
R.1 W.
R.1 E.
R.2 E.
Moyie River
Tp. 62 N.
Myrtle Cr.
Bonners Ferry
RIVER
Katka
Snow Cr.
Cow Cr.
Caribou Cr.
Tp. 61 N.
1
2
3
4
5
6
7
8
9
10
11
12
13

VIII

CORRA LINN DAM

On December 31, 1931, the Commission received the following telegram from James J. Warren, President of the West Kootenay Power and Light Company, Limited: "West Kootenay Power and Light Company Limited requests the opportunity of appearing before the International Joint Commission at the meeting of that Commission to be held in Montreal on Thursday the seventh day of January next for the purpose of reporting on its works at Corra Linn and the state of the present level of the water of Kootenay lake at the international boundary."

This was the first formal intimation that the applicant proposed to change the site of its works on Kootenay river from Granite to Corra Linn. It will have been noted in the last chapter that Dr. Mendenhall in his Interim Report on behalf of the United States Geological Survey referred to changes in the plans for the applicant's project involving the construction of a dam at Corra Linn about four miles below the Granite site.

It may also be noted that in the Reply of the Applicant to the Supplemental Response of Idaho, the statement is made that "while the applicant's application for storage rights on Kootenay lake based upon permanent work to be constructed at Granite, British Columbia, was pending, it has constructed a dam on the Kootenay river at Corra Linn, British Columbia, which point is from five to six miles below Granite and about nine miles below the outlet of the West arm of Kootenay lake."

It appears from these documents that a new application on behalf of the West Kootenay Power and Light Company in connection with the dam at Corra Linn overlapped the later stages of the application in connection with the dam at Granite.

Amended Application of West Kootenay Power and Light Company, Limited. On February 15, 1932, there was filed with the Commission the Amended Application of the West Kootenay Power and Light Company for approval of works at Corra Linn in the Kootenay river and for the right to store water in Kootenay lake. (Appendix O.)

The Amended Application was communicated to the Commission by the Under Secretary of State for External Affairs of Canada, for appropriate action.

Objections. In a letter dated March 21, 1932, E. P. Davis & Company, of Vancouver, B.C., filed an objection to the Amended Application, on behalf of The Alberta and British Columbia Exploration Company and the Trustee in Bankruptcy of the Kootenay Valley Power and Development Company, basing their objection on the following grounds: "(1) That the raising of the water in Kootenay lake will result in damage to the property of our clients. (2) That the raising of the water in Kootenay river will result in damage to the property of our clients. (3) That any interference with the free flow of the waters of Kootenay river at high or low water will damage the property of our clients by interference with the natural drainage of the said property. (4) That the raising of the level of the waters of Kootenay river will necessitate the increasing of the dikes protecting our clients' property. (5) And on such other grounds as our clients may be advised by counsel."

Objection was also made by W. A. Trufit, Box 992, Nelson, B.C., in a letter dated March 22, 1932, on the ground that the proposed storage would

"have a tendency to cause floods at high water period, also to isolate land on the north shore above Grohman creek in winter time by causing the channel to freeze, thus taking away our only present means of getting out."

On March 24, 1932, a request was received from the Attorney-General of Idaho for an extension of time to June 1, 1932, within which to file a Statement in Response to the Amended Application.

Approval of Applicant's Plans by Canadian Government under Navigable Waters Protection Act. There was filed with the Commission copy of an Order in Council of the Canadian Government dated August 26, 1932, approving of the plans filed by the applicant company upon the conditions set out therein.

Fetterly Report. There was also filed with the Commission, by the Dominion Water Power and Hydrometric Bureau of the Canadian Government, copy of a report by P. A. Fetterly, an officer of that Bureau, entitled "Report on Soil Conditions in Kootenay Valley, B.C., and Idaho, U.S.A., dated February 20, 1932". (Appendix P.)

Effect of Operation of Corra Linn Dam. On February 27, 1932, the Commission telegraphed the applicant company inquiring if the gates of the Corra Linn dam were being kept open, to what extent the level of the lake had been reduced thereby, and what was the present level.

The same day the following reply was received:—

"Your wire twenty-seven Kootenay lake. Storage gates Corra Linn dam open to pass all water that will naturally pass out of Kootenay lake through Grohman narrows and have been so open since January eighth and will so remain open stop Level of lake at Nelson gauge reduced by February twentieth to elevation seventeen thirty nine point nought five or three point two four inches below zero Nelson gauge and said zero is average low water mark. In consequence of ten days thawing weather lake level has risen to elevation seventeen thirty-nine point two seven to-day being up about two point six inches from low point."

Congressman French. In a letter to the Commission dated May 21, 1932, Congressman Burton L. French transmitted complaints from the drainage interests in Idaho to the effect that the gates in the Corra Linn dam were being operated in such a way as to cause anxiety in the Bonners Ferry district, particularly in view of the fact that there was an unusual amount of snow in the mountains and there was already high water in the river, which might later develop into serious floods.

These complaints were taken up through the Dominion Water Power and Hydrometric Bureau and it was ascertained that the dam was being so operated as to insure no back-water effect on Kootenay lake, and therefore on the river on the Idaho side. Federal engineers of Canada kept in close touch with the situation, and every facility was given to the United States federal and Idaho engineers to satisfy themselves that the dam was being operated in accordance with the instructions of the Commission.

Response of Idaho and Drainage Districts 1 to 13 to Amended Application. On May 8, 1933, there was filed with the Commission the Response to the Amended Application of the West Kootenay Power and Light Company, on behalf of the State of Idaho and Drainage Districts 1 to 13, in the County of Boundary. (Appendix Q.)

Public hearings at Nelson, August 24-26, 1933. It had originally been intended to hold a public hearing in June, but in view of the death of Mr. McCumber and the necessity of giving his successor sufficient time to study the record and familiarize himself with the issues involved, it was postponed until August 24, when it was held in the city of Nelson, British Columbia.

Appearances. The following appearances were entered:—

J. E. Read, K.C., Ottawa, Legal Adviser, Department of External Affairs, representing the Canadian Government.

J. T. Johnston, Ottawa, of the Department of the Interior, representing the Canadian Government and the Department of Indian Affairs, accompanied by A. J. Matheson and T. M. Patterson, Ottawa, Hydraulic Engineers of the Dominion Government Service attached to the Department of the Interior.

C. E. Webb, Vancouver, B.C., District Engineer of the Dominion Water Power and Hydrometric Bureau.

A. C. Whitehouse, Vancouver, B.C., Assistant Hydraulic Engineer of the same Bureau.

W. E. Keyt, Nelson, B.C., Acting District Engineer, representing the Department of Public Works of Canada.

J. C. MacDonald, Vancouver, B.C., Comptroller of Water Rights of the Province of British Columbia.

J. A. Metzger, Washington, D.C., representing the State Department, United States Government.

R. W. Davenport, Washington, D.C., Hydraulic Engineer, United States Geological Survey.

T. R. Newell, Boise, Idaho, District Engineer, United States Geological Survey.

L. T. Jessup, Bonners Ferry, Idaho, Consulting Drainage Engineer, United States Department of Agriculture.

G. E. Clark, Salt Lake City, Utah, District Counsel, United States Indian Irrigation Service.

L. M. Holt, Salt Lake City, Utah, Supervising Engineer, United States Indian Irrigation Service.

Bert H. Miller, Boise, Idaho, Attorney General, State of Idaho.

M. A. Thometz, Boise, Idaho, Assistant Attorney General, State of Idaho.

R. W. Faris, Boise, Idaho, Commissioner of Reclamation, State of Idaho.

Guy C. McGee, Bonners Ferry, Idaho, Special Deputy Commissioner of Reclamation, State of Idaho.

O. C. Wilson, Bonners Ferry, Idaho, Attorney for various drainage districts and land owners in Boundary County, Idaho.

J. E. Blair, Spokane, Washington, Attorney associated with Mr. Wilson.

Patrick A. Walker, Bonners Ferry, Idaho, representing Boundary County and various land owners therein.

E. E. Sargeant, Spokane, Washington, Attorney, Great Northern Railway Company.

J. M. Doyle, Spokane, Washington, General Agent, Great Northern Railway Company.

Fred Graham, Seattle, Washington, Agricultural Agent, Great Northern Railway Company.

E. A. Dye, Spokane, Washington, Assistant General Freight Agent, Great Northern Railway Company.

J. E. Brawley, Spokane, Washington, representing the Operating Department, Great Northern Railway Company.

R. C. Crowe, Trail, B.C., Counsel for the West Kootenay Power and Light Company, Limited.

L. A. Campbell, Trail, B.C., Vice-President and General Manager, West Kootenay Power and Light Company, Limited.

W. J. Tindale, South Slocan, B.C., Hydraulic Engineer, West Kootenay Power and Light Company, Limited.

A. E. Wright, Hydraulic Engineer, West Kootenay Power and Light Company, Limited.

Fred Matthews, Agriculturist, West Kootenay Power and Light Company, Limited.

Sherwood Lett, representing the Alberta and British Columbia Exploration Company, and the Trustee in Bankruptcy of the Kootenay Valley Power and Development Company, Limited.

James Anderson, Hydraulic Engineer, Kootenay Valley Power and Development Company, Limited.

E. H. Tredcroft, Hydraulic Engineer, Kootenay Valley Power and Development Company Limited.

A. L. McCulloch, Creston, B.C., representing the Creston Reclamation Company.

Rufus Woods, member of the Columbia Basin Commission, and representing that Commission in the State of Washington.

W. E. Southard, Ephrate, Washington, Trustee, Columbia Development League.

J. J. Trail, Toronto, Hydraulic Engineer, representing Dr. T. H. Hogg, Consulting Engineer to West Kootenay Power and Light Company, Limited.

Mr. Magrath. In opening the hearing the Chairman, Mr. Magrath, referred to the broad purposes of the Commission in the following terms: "As you know this Commission has been functioning for nearly a quarter of a century, and there have been times when I have felt that its opportunities for usefulness have been less than they might be because of lack of understanding on the part of the public in both countries of the extent and unique and highly important character of the work entrusted to it.

"No one questions the desirability of a fire brigade in any modern town, even though fires are infrequent. Not the least important of the functions of this Commission is that which makes it an international agency, to remove causes of dispute before they develop into grave international problems. So long as human nature is what it is, differences are bound to arise between individuals or groups of people, and as there are judicial bodies to deal with differences within one nation so there must be machinery to adjust differences between the peoples of two neighbouring countries. So far as the United States and Canada are concerned that machinery is furnished by the International Joint Commission, which, in addition to its more restricted powers, has authority to finally dispose of any issue arising between these two countries, provided it is referred to the Commission with the approval of the Senate of the United States and the Parliament of Canada.

"It is an arresting thought, when we see in the crowded thoroughfares of a great cosmopolitan city like New York, people of all races and languages meeting and passing, adjusting themselves unconsciously to the needs of the multitude, living up to what one may call the doctrine of the street, that the same spirit of give and take applied to the mutual interests of nations would go a very long way towards bringing about the era of universal peace and good will that the world so badly needs."

R. C. Crowe. In opening the case for the applicants, Mr. R. C. Crowe explained how and why the applicant company had changed its plans from the earlier site at Granite to a dam at Corra Linn. He said that the application was for " storage of water in Kootenay river and Kootenay lake that will result in the natural level of the water at the international boundary line being somewhat raised," and he went on to say:—

" We made a similar application in 1929, when our work was based on the idea of building a dam at Granite. A hearing was held in Bonners Ferry, Idaho, in November, 1929, when it was deemed advisable that further investigation should be made and further time given, and the hearing was adjourned in order to give time for this investigation.

" About this time the Consolidated Mining and Smelting Company of Canada, Limited, having an international problem which was then before your Honourable Commission, had given an undertaking to this Commission and was doing everything possible to carry out this undertaking, that very large remedial works would be constructed at Trail, British Columbia, to give relief to the nuisance that was complained of—the smelter smoke of this Company on the Washington side of the international boundary line. The construction and operation of these remedial works would require a very large block of additional power which was not then available from the Power Company.

" Those in charge of the Power Company's affairs realized that it would take considerable time to complete the investigation itself at Bonners Ferry; and if they waited for this and then for the storage application to be heard, and if allowed, more time would be required than the Consolidated could afford to wait for, the Power Company then looked about to see if another power site was not available on the Kootenay river. After some investigation it was ascertained that the Corra Linn rapids could be used as an additional power site, and by the building of a dam there it could supply a head for this power plant, and it was ascertained that it was quite possible to use the same dam as a dam to hold the storage in Kootenay lake, should a storage application ever be granted.

" The building of the Corra Linn power plant was wholly Canadian in purpose and effect. In itself it does not and will not raise the levels of the waters of the Kootenay lake or river at the international boundary line. By operations, such as the closing of the gates when application for storage is allowed, those waters could be raised. The Power Company then amended its application, basing its project upon Corra Linn dam instead of Granite, and filed its application on or about February, 1932."

Mr. Crowe stated that the Power Company immediately proceeded to prepare its engineering data and as fast as they were made ready and put into proper form, they were filed with the Secretaries of the Commission and copies supplied to the engineering representatives of the two Governments and Idaho, in order that all interested parties should have ample time to thoroughly investigate the data.

Mr. Crowe gave the following outline of the evidence embodied in these statements:—

Physical Conditions. " The Kootenay river, rising in the Rocky mountains of British Columbia, flows southward into Montana, westward and northerly through Montana to Idaho, past Bonners Ferry, and northerly from Bonners Ferry to the international boundary line through a flat valley that has been reclaimed, the owners of which are to-day represented by Mr. Wilson. After crossing the international boundary line the river passes through further flat reclaimable lands in British Columbia. The Creston Reclamation Company, Limited, is represented by Mr. McCulloch and the Reclamation Farm project by Mr. Lett and Mr. Anderson.

"The river enters Kootenay lake at Kootenay Landing. Kootenay lake is a very large natural storage basin or reservoir. At Proctor the lake extends into what is known as the West arm. Proctor is shown on the aerial map that we have here and Mr. Tindale will point out the location. I may say that the lower mosaic shows the lands on Upper Kootenay lake and river to Porthill on the international boundary.

"The waters of Kootenay lake enter the West arm at Proctor, flow down through various widths of channel passing Nelson and about two or three miles below Nelson pass through a very narrow channel called Grohman narrows, the control point of this waterway which results in the lake being formed behind it. Passing through Grohman narrows and Granite, we come to the Corra Linn dam and power site. Below Corra Linn dam and power site the West Kootenay Power and Light Company have three other power plants, Upper Bonnington, Lower Bonnington and South Slocan. Fifteen miles further on the river enters into the Columbia river. The Columbia river flows eighteen miles south to the international boundary line, enters the State of Washington and passes through to the sea.

Power Sites. "On the stretch of the Kootenay river between Nelson and Castlegar there is a drop of some 365 feet, a great deal of which has already been taken advantage of for the development of electricity by the Power Company in the four plants which I have just mentioned. In the State of Washington there is a very large available power head in the Columbia river which will be assisted by any waters reaching it from Kootenay lake. At the present moment there is a very large project to be undertaken by the State Government of Washington, assisted by the Federal Government of the United States, known as the Columbia Basin Project, which project is represented here to-day by Mr. Woods and Mr. Southard.

Water Levels. "Owing to the fact that the source of Kootenay river and its watershed of 19,450 square miles is very largely in the mountains of British Columbia, Montana and Idaho, there are created great variations seasonally in the amount of water flowing in the river. A great part of the precipitation which supplies the water is in the form of snow that accumulates in the mountains during the winter months, and upon the advent of warmer weather melts, causing flood conditions in the river and lake.

"The period of rising levels commences about the first of April and reaches flood proportions in May and June. For the next six months the waters gradually recede, reaching low water generally during the month of February. In an average year, speaking more or less in generalities, at the flood peak the waters in Kootenay river would amount to some 107,000 c.f.s. passing a given point, Grohman narrows. When you come to the winter time, the very low period, you will get as low as 4,800 c.f.s."

In reply to a question by the Chairman as to the figures representing average high water and average low water, Mr. Crowe said:—

"We have a record in the winter of 1930 when there was a flow of 4,100 c.f.s. In order to utilize some of that great quantity of water during the eight or nine months of the year when it is naturally given to us, our plants have been developed to utilize 10,400 c.f.s. and to attain approximately this flow, extra water can be stored in Kootenay lake by the works described in our application without in any way, we submit, injuring any other interested party, thus making it possible for the Power Company to utilize some of the surplus water of the summer and fall seasons for use during the low water period in the winter. While we can operate our plant to capacity during eight or nine months in the year, we will be down to half that capacity during four or five months in winter time. We cannot store electrical energy in the summer time and use

it in winter but we can store surplus water, and the objective of the application is that we may be allowed to store surplus water so that it can be run off in the winter time.

"The necessity for this has become most urgent in consequence of the entrance into the fertilizer business of the Consolidated Mining and Smelting Company. The Consolidated Mining and Smelting Company can produce a certain quantity of metals and fertilizer in summer time but, having to abate a smoke nuisance three hundred and sixty-five days in the year, it must have a continuous supply of power to enable it to do that. The only power available in that part of the country is that of the West Kootenay Power and Light Company, which at present has an installed capacity, in its four plants, of 224,000 horse-power but which is actually able to develop regularly during low water in winter time only 50 per cent of that capacity or 112,000 horse-power. Actually it has been limited to 98,000 and 96,400 horse-power as in the month of February in 1929 and 1930 respectively."

Continuing his summary of the evidence submitted on behalf of the applicant, Mr. Crowe said:—

Effects of Reclamation. "Reclamation of large areas of the natural flood plains of the river has two definite effects. I am speaking of the reclamation of the lands in British Columbia from Kootenay lake up to the international boundary line, the Creston project, and the Reclamation Farm project, and also of the reclamation area from the boundary line up to Bonners Ferry. These two definite effects are: The increase of the flood level of the water if the river is deprived of a large flood plain which would enable it to spread out and lower its level; and a decrease in the level of the lake in the low water season, since the water which would have been stored upon the flood plain under natural conditions and have run out to the lake and river throughout succeeding months after the river fell, has been confined to a narrow channel and carried off immediately."

Mr. Crowe pointed out that the effect of diking in Idaho was discussed in the Engineering Report of March 10, 1933, filed on behalf of the applicant. In that report it is said: "Reclamation of these flat lands will naturally decrease the storage capacity for floods. It will have the effect of raising the elevation of the lake by reason of the reduced storage area, of raising the river elevations between Kootenay Landing and Bonners Ferry because of the reduced storage area and smaller flood channel, and of raising the water elevation and increasing the flow of the river at Nelson on account of the lake being higher than for similar floods under original conditions before reclamation of the land."

"We have computed," continued Mr. Crowe, "and shown in these reports the total increase in flood level from not only the reclamation of the districts in Idaho but of the total amount of land that can be reclaimed in British Columbia, that is these thirteen districts in Idaho and the diking of the Reclamation Farm in British Columbia. The maximum increase in the main lake elevation from Kootenay Landing to Nelson would be 1·17 feet. The increased flow during that flood period would be 8,287 c.f.s." . . .

Corra Linn. Turning to the development at Corra Linn, Mr. Crowe said: "I have already stated that we built a dam at Corra Linn which can be used to supply a head for the development of power and which is also capable of creating storage in Kootenay lake if this application is allowed. Between there and Granite the river channel has been straightened and made more even to allow a greater and more even flow by taking out various bars and boulders and blasting out several rock corners. The distance from Corra Linn to Granite is five miles. . . .

"The dam which has been constructed at Corra Linn to supply a head for the development of power can be used for that purpose without raising the level

of Kootenay lake or river at the boundary line. It is so constructed that if our application is allowed by this Commission it can be operated to provide the storage sought. It can be converted into a storage dam which will result in the level of the lake being raised at the boundary line, and that, we hope, may be done from September 1 to April 1. At this time of the year the river is falling and approaches during the winter season its lowest period. It is then that we wish to store up the water.

"This dam at Corra Linn is constructed to pass over 200,000 cubic feet per second. Two hundred thousand cubic feet per second was the flow of the greatest flood of which we have any record, the flood of 1894. A dam is provided with 14 large sluice openings with suitable gates which when all open will discharge 200,000 cubic feet per second, when the elevation of the forebay above the dam is at elevation 1739·50. With the elevation of the water in the forebay of the dam at elevation 1745 those gates when all open will discharge 272,888 cubic feet per second, or, roughly, 72,000 more than the greatest flood we have on record.

"Confirmation of our figures of what those sluice gates and that dam will discharge was obtained by us during last year's flood peak. Previous to that they were computed figures, but last year with the dam in operation and a flood in effect we were able to confirm them by absolutely actual measurement up to the point of that flood which was 110,000 cubic feet per second. We could not measure beyond that because the flood was not high enough.

"During last year, when there was 110,000 cubic feet per second flowing in the river, we required to have only eight of the fourteen gates opened. At the elevation that I gave the water was actually ten feet below the crest of the dam. It was shown last year as a fact that instead of any backwater being created by the dam during the flood period of 1932 there was actually a slight lowering of the lake from what it would have been had the dam not been in operation and the river improvements above the dam not carried out. The lowering of the lake actually effected amounted to 0·12 of a foot on May 7, 1932, when the flow was 39,500 cubic feet per second at Nelson. . . .

Grohman Narrows. "Before any further substantial or practical flood relief can be obtained Grohman narrows must be opened up and the channel enlarged, and this is a part of our present proposition. You understand that we propose to enlarge it by the removal of 250,000 cubic yards of material. It will be of interest to you to know that there have been in the past many suggestions that Grohman narrows should be opened up as a part of the reclamation scheme in Idaho and British Columbia for the same purpose of lowering the flood waters of the lake and river. Grohman narrows could not be opened up until a control dam is erected below Grohman narrows, because if you do the water at the low water period will continue to pass in greater volume and protecting the interest of navigation on the lake would prevent it. You must have a control below Grohman narrows to hold the low water at a proper stage for navigation in the lake and river.

"Now, we have the dam for power purposes and will just open Grohman as we need it for our storage, which sets the basis for this reclamation and the basis that several of them speak of as being a starting point for the reclamation idea. This subject will be discussed by others at a later time."

Concluding an analysis of various figures and computations, Mr. Crowe said that they proved that if their application was accepted by the Commission and they were allowed to proceed with the works described, including the excavation of 250,000 cubic yards at Grohman narrows substantial progress would be made in reducing the flood levels throughout the whole of Kootenay lake and Kootenay river as far as Bonners Ferry, and these works would give a further factor of safety to the reclamation districts.

Kootenay Lake Storage. Mr. Crowe then proceeded to discuss in detail the storage of water in Kootenay lake based on Corra Linn dam and its effect on the lake and on the river both north and south of the international boundary. "The company" he said, "proposes to effect the storage by first permitting passage of the normal seasonal high flow in the spring and summer months and by partially closing the sluice gates in the dam when the water at Nelson reaches a stage of approximately four feet," and he added "that is elevation 1,743·32 Geodetic Survey of Canada datum, 1928, above the average low water mark. Then, after the thirty-first of August each year by allowing the lake to slowly rise until it has reached the stage on the main lake of 6 feet above the said average low water mark at the end of September. By control from Corra Linn dam the main lake would be held not higher than this elevation at any time, but would be drawn down during the low water months as required for power, or to fulfil the following conditions: The main lake elevation would not be higher than elevation 1,744 on the first of February; 1,742·4 on the first of March; and 1,740·8 on the first of April, if the storage season does not terminate before this date due to the annual flood rise."

T. H. Hogg Statement. Mr. J. J. Trail, Hydraulic Engineer, presented the following statement prepared by Dr. T. H. Hogg of the Hydro Electric Power Commission of Ontario, acting as Consulting Engineer to the applicants:—

"The writer's connection with this work commenced in January, 1932, when he was called in by the company to give advice during the progress of the studies upon which reports and statements to be prepared would be based. During the intervening eighteen months, he has been in constant touch with the work that has been going on, has received progress reports as field investigations and office studies have advanced, and in connection therewith has been in communication with Mr. L. A. Campbell and other officials of the company, and with Mr. J. T. Johnston of the Dominion Water Power and Hydrometric Bureau. Independent computations have been made by him, and critical examinations of the studies made by the company and by the officers of the Dominion Water Power and Hydrometric Bureau have engaged his attention from time to time throughout this period. The writer also visited the plants of the company on the Kootenay river, and made a complete examination of the river from Trail, B.C., to Bonners Ferry, Idaho.

Proposals of the Company. "The application of the company now before the International Joint Commission is for permission to make use of Kootenay lake as a storage basin during certain months of the year, in such a way as to benefit its power plants during low water periods without causing damage to other riparian interests. It is proposed that on the approach of the period of low flow in the fall months, a portion of the natural flow of the river shall be retained in Kootenay lake, raising the lake to a maximum of six feet above the average low water mark, this stored water to be used in the ensuing winter months or discharged through the dam at Corra Linn, so that the level of the lake will be reduced to the average low water mark at or about the end of March, or by the beginning of the seasonal spring rise.

"The company has constructed at Corra Linn—ten miles downstream from the outlet of the lake at Nelson—a dam and power development, which are equipped with sluices having a capacity greatly in excess of the maximum flow of the Kootenay River, as indicated by the records of the past forty years. It has also made certain improvements in the river upstream from Corra Linn, which increase the capacity of the river channel, and is prepared to excavate additional large amounts of material at Grohman narrows, for the purpose of further in-

creasing the capacity of the river channel. By means of the improvements already made, the level of the lake during flood periods will be lowered, which will be beneficial to interests on the lake and on the river upstream from Kootenay lake, and these benefits will be appreciably increased by the improvements which it is proposed to make at Grohman narrows.

Dam and Power House at Corra Linn. " The Corra Linn dam and power plant are located on a site formerly known as Corra Linn Rapids, ten miles downstream from the outlet of the lake at Nelson, B.C. The power house contains three vertical, Francis, single runner turbines, capable of producing 19,000 horsepower each under a head of 53 feet. The power house is on the right bank of the river adjoining the dam, which crosses the river at a slight angle to the general direction of flow. Immediately adjoining the power house is a bulkhead section of the dam, 126 feet in length, with top at elevation 1,751, folloyed by a sluiceway section, 658 feet long, and a gravity section, 950 feet long, with top at elevation 1,749. The whole of that portion of the dam situated between the original river banks is occupied by the sluiceway section, comprising fourteen sluices, each with a clear opening of 34 feet with sills at elevation 1,716. The sluices are closed by motor operated steel gates, 32 feet in height. Two travelling hoists are provided, by means of which all gates may be raised clear of the water surface and suspended from an overhead steel structure, if necessary, for flood discharge, the bottom of the gates when raised being at elevation 1,749. To obviate any danger of failure of the power supply used for operating the gate hoists, connection to all of the company's four plants on the river is provided for this power supply, and arrangements have also been made for manual raising or lowering of the gates.

" The calculated discharging capacity of the sluices, confirmed by tests made during the high water period in 1932, is far in excess of the maximum flow of the river, as indicated by past records. Kootenay lake reached an exceptionally high stage in 1894; accurate records of water level and flow are not available, but from examinations and analyses of the many reported high water marks, it is concluded that the lake reached an elevation of 1,771, and the river at Nelson a stage of 1,767·5. The discharge corresponding to these levels is estimated to have been from 200,000 to 225,000 cubic feet per second. At no time in the ensuing thirty-nine years did the lake reach a stage within seven feet of the high stage of 1894, and the maximum discharge since 1894 was slightly under 150,000 cubic feet per second. The sluices are capable of discharging a quantity equal to the 1894 flood with a forebay elevation of 1,741·5, and over 300,000 cubic feet per second with forebay elevation of 1,748. The flood discharging capacity of the dam is thus very generously proportioned.

" The dam and power house are so arranged that they may be operated as a power development solely, without affecting lake levels. The arrangement of the sluices and their control, however, enables them to be used also as part of the proposed storage works, that is to say, to control lake levels. Without storage on the lake, the ordinary operating head at the power house is in the neighbourhood of 53·5 feet, reduced during an average flood to 47 feet. It is under these conditions that the plant is being operated at the present time. The forebay is now maintained at such a level that it does not affect Kootenay lake levels.

River Improvements. " The length of the channel from Nelson to Corra Linn, as noted above, is ten miles. Under natural conditions there were a number of constricted sections in which the water had a high velocity and a steep gradient. To provide for reasonable forebay elevations at Corra Linn, without causing backwater upstream to the lake, over 700,000 cubic yards of rock, gravel and boulders were excavated at these places, six in number.

" The extent of these improvements will be appreciated when it is pointed out that at one of the improved sections, about three-fourths of a mile upstream from the dam, where at low water the width was only 150 feet and where rapids and falls existed in nature, the improved channel, having a width of 400 feet, has been created by the removal of 250,000 cubic yards of rock. At each of the other improved sections, major obstructions to the flow have been removed. At Granite, five miles below Nelson, channel improvements involved the removal of 120,000 cubic yards of rock.

" Investigations of lake levels during 1932 and 1933 have shown that, on account of these improvements, even with the forebay at Corra Linn raised to suitable operating levels, the level of Kootenay lake has been lowered. The following typical readings of water levels exemplify this:—

Date 1933	Elevation at Nelson	Discharge (c.f.s.)	Former Nelson elevation for same discharge	Lake lowering (feet)
May 18	1,748·19	51,400	1,748·59	0·40
May 30	1,751·17	74,000	1,751·73	0·56
June 7	1,754·44	99,750	1,754·98	0·54
June 17	1,756·99	123,900	1,757·78	0·79
June 23	1,758·42	139,300	1,759·40	0·98

Proposed Improvements at Grohman Narrows. " At Grohman narrows, about two miles below Nelson, there is a constricted reach of the river having a fall under natural conditions of 6 to 8 feet in a distance of a mile. This bottle neck, through which all water discharged from Kootenay lake must pass, is the principal factor in determining the height to which the water level at Nelson must rise to allow any given quantity of water to flow down the river. Excavation at this section, whereby the channel would be enlarged, would result in lower lake levels during flood periods to the benefit of riparian interests on the lake and on the river upstream from the lake.

" The company proposes that large amounts of rock, gravel and boulders shall be removed from the channel widening and enlarging the effective waterway. The quantity of material that it is proposed shall be removed, amounts to 250,000 cubic yards, which will increase the effective area of the channel by 35 to 40 per cent. These increases in effective waterway, it should be noted, are in the most constricted section of the channel, where increases in cross-sectional area will be most effective.

" These proposed channel improvements at Grohman narrows will make possible a very considerable lowering of Kootenay lake in time of flood. This lowering of the lake surface will result in reduced water levels at the same time throughout the river from the lake to above Bonners Ferry, with consequent reduction in seepage into the drainage districts, and increased protection from flooding by failure or over-topping of dikes.

Columbia River Power Sites. " Attention generally has been concentrated on the effect of the company's proposals upon the lake and that part of the river from the lake to Bonners Ferry. There are benefits of great magnitude accruing to other parts of each country, to which attention should also be given.

" The Kootenay river, rising in Canada, crosses the international boundary to enter the State of Montana near Rexford, recrosses into Canada at Port Hill, and finally joins the Columbia river twenty-eight miles upstream from the point where the latter enters the State of Washington. Benefits of

immense value will accrue to power sites on the Columbia river below the international boundary. The storage proposals of the company, if agreed to, will result in appreciable increases in the flow of the Kootenay river during the months of December, January, February and March, and this increased flow will benefit not only the power sites of the West Kootenay Power Company, but also those sites on the Columbia river downstream from the international boundary.

"The Columbia river from the international boundary to its mouth has a fall of 1,300 feet which might be largely concentrated in ten sites. Investigations have proceeded on a number of these and, I understand, it is proposed to proceed with power development at the first site below the boundary at Grand Coulee where a concentration of 355 feet is feasible. Below this, in a distance of 200 miles are five other sites of which one is already developed, the six sites having together a head of 859 feet.

"The rule curve of the company's storage proposals is designed to provide, so far as possible, a constant outflow from Kootenay lake with storage of 9,300 cubic feet per second. The natural flows during the past years of record have of course fallen at times far below this. The firm power capacity of an hydro-electric development is determined by the minimum dependable flow of the river upon which it is located. The dependable flow at all sites on the Columbia river will be increased by the difference between the minimum outflow of Kootenay lake under natural conditions and the outflow with the Kootenay lake storage proposals operating.

"I estimate that it will be possible to increase the firm power capacity of the development at Grand Coulee by 140,000 horse-power by means of the storage scheme and that the firm power capacity of the six sites referred to above will be increased by over 300,000 horse-power.

"Attention should be drawn to the fact that the increased power from the augmented flow is available in those months of the year when power demands are greatest. Thus the benefits to sites on the Columbia river are of a very substantial nature.

Summary of Results. "Extensive field and office investigations have engaged the attention of a number of governmental and private organizations in connection with this application. Great amounts of physical data have been collected, and extensive calculations made, to arrive at accurate information on its many features. There is always a possibility, in such a case, that the essential issues will be obscured by the great mass of information collected for the purpose of giving accurate information about those issues, and for that purpose alone. I would therefore draw your attention to the two questions that require an answer in order that a fair decision may be reached. These questions are: (1) What results may be expected from the improvements already made and those proposed in the Kootenay river from Nelson to Corra Linn? and (2) What results may be expected from the storage proposals of the company?

"The answer to the first of these is found partly in the experience during the flood seasons of 1932 and 1933 and partly in the results of calculations. The records of water level on the lake in 1932 and 1933 show quite definitely that, due to the river improvements made, the lake surface was appreciably lower than for the same outflow under natural conditions. An examination of the conditions at Grohman narrows leads at once to the conclusion that excavation here will cause further lowering under flood conditions, and calculations confirm this conclusion. The lake lowering effected by the completed and proposed improvements, were there a repetition of the flood of 1894, would amount to over three feet.

"Manifestly, if the water surface in the lake is lowered, the water surface in the river will be lowered as one proceeds upstream to Bonners Ferry by amounts less than the lake lowering, but nevertheless by appreciable amounts. Without any doubt those flood conditions will occur at some time in the future, whereby the overtopping of the dikes and flooding of the reclaimed lands will be prevented by the improvements. Beneficial effects will be realized in every year, whether dangerous flood stages are reached or not, the lower river levels giving protection from dike failures and reducing seepage into the districts.

"The second question above has to do with the results of the storage proposals. It should be noted that the water surface in the lake is not raised for storage purposes until the end of the growing season, and that the maximum height of the river surface at the drainage districts during the storage period is about five feet below the lowest level of the land, and this high level occurs in the winter season. By the beginning of April the lake and river will be returned to natural level. Thus, in the growing season, the water level in the river will be unaffected by the storage proposals, and in the winter season the maximum levels are such as to cause no damage or inconvenience.

"The storage proposals also pass on to the sites on the Columbia river in the State of Washington very great advantages in years of low river flow, increasing the firm power capacity of the sites and increasing the number of kilowatt hours that may be generated in the winter months when energy is in greatest demand, advantages of much greater magnitude than those accruing to the company itself at its power sites on the Kootenay river.

Conclusion. "The hydraulic studies of the proposals of the company that have been carried on by different agencies, all arrive, as is to be expected, at the same results qualitatively. The claim of the company is that the river improvements already carried out, and those proposed, will lower the flood level on Kootenay lake and on the river above the lake. This claim is confirmed by the results of the studies made by the company, by the Dominion Water Power and Hydrometric Bureau, I believe too by the United States Geological Survey, and also by observations during the high water period in 1932.

"The quantitative results differ, of course, as all such results do when carried on by independent organizations. The essential fact remains, however, that all agree that the lake and river levels will be lowered during periods of flood. This lowering will be of benefit in every year, especially in the event of the repetition of such high flows as occurred in 1916 and 1933."

W. E. Southard. Dr. Hogg's reference to power developments on the Columbia river and their relationship to storage on Kootenay lake was enlarged upon by Mr. W. E. Southard of Ephrata, Washington, who described the project of the Grand Coulee dam.

J. C. MacDonald. Mr. J. C. MacDonald, Comptroller of Water Rights of British Columbia, said that the provincial authorities were entirely in sympathy with the project of the applicants and had granted them a licence permitting them to store water in Kootenay lake provided they secured the consent of the International Joint Commission. Referring to the Columbia river proposals and the possibility of them being combined with storage in British Columbia lakes he said that if any reasonable proposition should be brought before the Government of British Columbia, it was quite within the bounds of possibility that legislation might be had for permitting such storage. "It is the intention of the Provincial Government," he said "in so far as I understand it and can express it, to co-operate with the people to the south in every possible way in securing further additional power sites."

J. E. Read. Mr. J. E. Read, Counsel for the Dominion Government, in introducing its case said:—

"The Government of Canada has always taken the position that it is open to any private interest to appear before the Commission and to ask for the authority of the Commission to carry out the works that it has in mind. So that in these proceedings the West Kootenay Power Company appears really in the nature of a private litigant, and the Canadian Government does not in any sense of the word appear before you as a litigant or as espousing the cause of the company.

"The position that the Government has always taken in proceedings that are being carried forward by a private interest of this sort is that it is the function of the Government to conduct such investigations and present such information and reports to the Commission as will assist the Commission in ascertaining the facts upon which it will base its judgment; and accordingly the Canadain Government has caused an inquiry to be made by the Dominion Water Power and Hydrometric Bureau into the various aspects of this case."

Johnston and Grover Report. Mr. J. T. Johnston of the Dominion Water Power and Hydrometric Bureau, presented a joint report prepared by himself and Mr. N. C. Grover of the United States Geological Survey, embodying an independent analysis of the company's proposals and their effect upon water levels.

KOOTENAY LAKE AND RIVER STUDIES

SUMMARIZATION OF HYDRAULIC STUDIES CARRIED ON BY THE UNITED STATES GEOLOGICAL SURVEY AND THE DOMINION WATER POWER AND HYDROMETRIC BUREAU IN RESPECT TO THE APPLICATION OF THE WEST KOOTENAY POWER AND LIGHT COMPANY, LIMITED, TO THE INTERNATIONAL JOINT COMMISSION FOR APPROVAL OF STORAGE PRIVILEGES IN KOOTENAY LAKE.

August 5, 1933.

The purpose of the joint memorandum submitted hereunder is to present to the International Joint Commission a concise statement of the conclusions which have been reached by the engineers of the United States and Canadian Governments, in respect to the effect of the proposals of the West Kootenay Power and Light Company, Limited, upon the water levels of Kootenay lake and of the reach of the Kootenay river extending through Kootenay flats from Kootenay Landing in British Columbia to Bonners Ferry in Idaho, and in respect to pertinent hydraulic features connected therewith.

Historical. At the hearing dated November 6, 1929, held at Bonners Ferry, Idaho, by the International Joint Commission in connection with the application of the West Kootenay Power and Light Company, Limited, for permission to construct and operate certain permanent works in and adjacent to the channel of the Kootenay river for storage purposes, an understanding was reached with the Commission that the officers of the United States Geological Survey and of the Dominion Water Power and Hydrometric Bureau, should collaborate in studying the hydraulic features of the company's proposals in so far as these would affect the water levels at and to the south of the international boundary, with a view to, if possible, reaching an agreement as to such effects.

In accordance with this understanding, arrangements were made for the mutual exchange between the two organizations, of all the hydraulic records and other pertinent physical data secured on either side of the boundary within the river reach in question. Arrangements were also made for the free inspection at any time of the river reach in either country by the governmental officials of the other.

At the hearing also, the West Kootenay Power and Light Company, Limited, advised that all records and engineering data secured or developed by the company's officers and engineers would be made freely available to the governmental engineers on both sides of the boundary.

Access to the company's Corra Linn plant and to the drainage districts was available at all times to both Canadian and United States engineers.

Following the understanding reached at the hearing, the undersigned (Mr. N. C. Grover, Chief Hydraulic Engineer, United States Geological Survey, and Mr. J. T. Johnston, Director, Dominion Water Power and Hydrometric Bureau), have proceeded with a study of the hydraulic features of the company's proposals in so far as these affect international waters. This included a study of the river reach from the Corra Linn dam, B.C., to Bonners Ferry in Idaho, a distance of some 134 miles. The computations in Mr. Grover's office have been the responsibility of Mr. R. W. Davenport, and in Mr. Johnston's office, of Mr. A. J. Matheson and Mr. T. M. Patterson. The field studies in the United States were the responsibility of Mr. C. G. Paulsen and later Mr. T. R. Newell of the United States Geological Survey, and in Canada of Mr. C. E. Webb, District Chief Engineer of the Dominion Water Power and Hydrometric Bureau in British Columbia.

As the hydraulic studies progressed on either side of the line, copies of the conclusions, together with supporting base data and computations, were exchanged, in order that each office should be at all times apprised of the progress made and of the conclusions being reached in the other office. The collaboration was in all respects and at all times highly effective and mutually satisfactory. The various studies and computations made by the applicant company were also made available to both governmental offices, promptly and with the utmost detail that could have been desired.

In proceeding with the studies, the hydraulic conditions were considered and analyzed as they obtained *prior to the initiation of any operations* on the part of the company, *as they obtain under existing conditions* with certain excavation completed in the Corra Linn-Granite reach, and *as they will obtain following the company's proposed excavation* of 250,000 cubic yards of material in and immediately below the Grohman narrows.

While—as was to be expected, in such intricate hydraulic computations as were involved in the analysis of the problem—differences in detail developed in respect to the weight to be given to certain hydraulic factors and in the details of computations, nevertheless the final results of the computations made at Washington and Ottawa, respectively, show very reasonable agreement in most of the essential conclusions which have been reached for presentation to the Commission.

The details of the analyses made in Ottawa are being filed with the Commission separately for record purposes. There is also being filed by Mr. Johnston a summary of the above mentioned analyses, together with comments upon the hydraulic features of the company's proposals.

All base data of the United States Geological Survey are being filed with the Commission separately for record purposes. There is also being filed a statement by Mr. Davenport in which important aspects of the company's proposals are discussed and also in which are presented the river level data on which the ground water and agricultural analyses are based. The latter statement may duplicate to a slight degree the conclusions herein.

The conclusions reached as a result of the studies follow:—

The Discharge Capacity of the Dam and Power House. With respect to the discharging capacity of the dam and power house:—

It is agreed that the Corra Linn dam has been constructed with a discharging capacity which, when all sluices are open and the power house operating, will permit the passage of well over 300,000 cubic feet per second before the forebay

level reaches the crest of the long gravity section of the dam at elevation 1749·0. This provides a very large factor of safety for future floods—the maximum known flood on record being estimated at not to exceed 225,000 cubic feet per second, occurring in 1894.

It is furthermore agreed that if Grohman narrows is improved as proposed by the excavation of 250,000 cubic yards, the discharging capacity of the dam is sufficient, if properly regulated and controlled, to permit the drawing down of the water levels on Kootenay lake and in the river reach extending upstream to Bonners Ferry to an elevation well below the elevations which would obtain under natural conditions.

Effect of the Project Upon Upstream Water Levels Under High Water Conditions. With respect to the effect of the company's project upon upstream water levels:—

It is agreed that, with the excavation which has been completed by the company to date in the reach of the river from Corra Linn dam upstream to Granite, and assuming the efficient control of the discharge through the Corra Linn dam, the Kootenay lake levels can be materially lowered during high water conditions. The lake stage for an extreme outlet discharge of 225,000 cubic feet per second would be lowered, approximately 1·0 foot according to the United States computation and 1·8 feet according to the Canadian computation.

It is agreed that, with an *additional* excavation of 250,000 cubic yards at Grohman, and still assuming efficient control of the discharge through Corra Linn dam, Kootenay lake levels would be further lowered. The lake stage for an extreme outlet discharge of 225,000 cubic feet per second would be lowered a total amount of 2·7 feet according to the United States computation and 4·05 feet according to the Canadian computation.

It is also agreed that with the excavation of 250,000 cubic yards at Grohman narrows, and assuming proper control of the Corra Linn dam, the water levels in the reach of the river extending through Kootenay Flats from Kootenay Landing in British Columbia to Bonners Ferry in Idaho, would be beneficially lowered during high water—the amount of the lowering decreasing progressively upstream from the lake and disappearing ordinarily at some point above Bonners Ferry.

Moreover, the effectiveness of a given lowering of the lake in producing lowering of the river upstream will vary with the flows through the flats, being greater for smaller flows and less for greater flows. The lowering of the lake is determined by consideration of both the outlet discharge capacity and the supply of water entering the lake, and by reason of the function of lake storage in adjusting between lake inflow and lake outflow, the lowering of the lake will be less relatively when the inflow exceeds the outflow and more relatively, when the outflow exceeds the inflow.

It may be explained that the relationship of the flows through these two reaches of Kootenay river above and below the lake, varies greatly at different seasons and in different years. The area of the drainage basin above Bonners Ferry is 73 per cent of that at Nelson and the records of runoff indicate that the average flow at the former point is 50 to 60 per cent of that at the latter point. There are of course rather wide departures from the latter ratio in the flows on different days or periods of the year. Records show a flow past Nelson of 60,300 cubic feet per second occurring on July 20, 1928, while on the same date the flow past Bonners Ferry registered as low as 21,900 cubic feet per second or 36 per cent of the former. On the other hand, there is on record a flow of 20,700 cubic feet per second, past Nelson, while on the same date the flow past Bonners Ferry was 35,000 cubic feet per second, or 169 per cent of the former.

In illustration of the conditions producing such variation of relationship it is conceivable that, with the lake at a high stage and a correspondingly high

flow past Nelson, a sudden spell of cold weather might drastically curtail the inflow above Bonners Ferry, and consequently, the flow in the river past that point. This condition is suited to maximum effectiveness of lake lowerings in producing lowerings of water levels in the river above the lake. On the other hand it is conceivable that, with the lake at a low level and a correspondingly low discharge at Nelson, a sudden period of high temperatures accompanied by rain might be productive of excessive inflows in the upper watershed which would produce very high flows at Bonners Ferry, while the discharge in the river below Nelson—governed as it largely would be by the lake level—would still be comparatively low. This condition is suited to minimum effectiveness of lake lowerings in producing lowerings of water levels in the river above the lake.

These variations of combinations of flow and storage factors make it difficult to place on record in simple form the exact amount of lowering of water levels between Kootenay lake and Bonners Ferry which is to be anticipated under all conditions as a result of the proposed Grohman excavation.

However, in the studies which have been made, various combinations have been considered, assuming regulation of the Corra Linn dam to produce the greatest possible lowering of lake levels. The United States computations have assumed that all sluice gates would be open between April 1 and about September 1 when storage operation would begin. The Canadian computations have assumed that a sufficient number of sluice gates will be open to provide free discharge past Nelson in each year from the commencement of the spring rise to the date upon which the lake surface falls to elevation 1743·83 in the autumn. These studies warrant the following conclusions:—

(*a*) That the excavation of 250,000 cubic yards at Grohman narrows will have a substantially beneficial effect in lowering the water levels throughout the Kootenay Flats reach.

(*b*) The Canadian computations show that the amount of this lowering will vary from 1 to 4 feet depending upon the relationship of the flow through the flats to the elevation of Kootenay lake, or, under free discharge, to the flow through the Kootenay river below Nelson.

The United States computations show that under the combinations of factors conceived as likely to occur at times of large floods, the lowering in Idaho would vary from 1 to 2 feet, such lowering being approximately 1·50 to 2·00 feet at Port Hill and 1·00 to 1·50 feet at Bonners Ferry.

(*c*) That properly planned additional excavation at the control points in the lake outlet (i.e. over and above the 250,000 cubic yards) would be conducive to a further beneficial lowering of the water levels in the Kootenay Flats reach by an amount proportional in some reduced measure to the amount of further excavation undertaken.

Effect of Company's Proposals on Water Levels During Storage and Draw-off Period. The company's proposals call for a maximum 6 feet of storage above the average low water mark on Kootenay lake, at Nelson, B.C.[1]

During the rising stage, the company proposes to open the sluice gates of the Corra Linn dam to allow all water to pass through the dam that would then be naturally flowing out of Kootenay lake, including the additional flow made possible by the excavation in the river above, or in other words to discharge the full capacity of the proposed enlarged channel.

The company proposes to effect the storage by first permitting the passage of the normal seasonal high flow in the spring and summer months and by partially closing the sluice gates in the Corra Linn dam when the water in Kootenay lake at Nelson reaches a stage approximately 4 feet (i.e. elevation

[1] While the wording of the Power Company's application with respect to the point of applicability of the six feet of storage has led to some confusion, the Power Company, the United States Geological Survey and the Dominion Water Power and Hydrometric Bureau are in agreement—as is evident from their respective computations—that the Company is asking for a maximum storage elevation of 1,745·32 on the main lake. This elevation is six feet above the average low water mark (elevation 1,739·32) at Nelson, B.C.

1,743·32 Geodetic Survey of Canada Datum, 1928) above the average low water mark and then, after the 31st of August each year, to allow the lake to slowly rise until it has reached a stage on the main lake of 6 feet above the said average low water mark at the end of September (i.e. to elevation 1,745·32).

The company proposes that the storage should at no time be increased above the said elevation 1,745·32. If it is in the interest of the company to do so in connection with the storage regulation, as it might be for example in a year of plentiful supply, the water level on the lake may be carried at that elevation throughout the months of October, November and December. The Company may hold the water at that elevation to the 7th of January in each year and the lake level would be gradually reduced throughout the succeeding months to about the end of March. The main lake elevation shall not, under the Company's proposals, exceed elevation 1,744 on the first of February, elevation 1,742·4 on the first of March, and elevation 1,740·8 on the first of April if a rise in river flow in late March does not prevent.

A careful analysis of the backwater effects resulting from the company's proposals, throughout the Kootenay flats reach was made in the respective offices of the undersigned—the Canadian and the United States computations being based upon somewhat different premises which tend to produce different results.

The Canadian computations were based on the computed actual supply to Kootenay lake for each storage season and on the assumption that the company would follow the storage program laid down on its drawing No. F-239, i.e. they were made with a view to providing 9,300 cubic feet per second to the company's power plants, in so far as possible, while keeping within the upper and lower storage limits shown on said drawing. These computations do not show what the effects would be, in the event that the applicant should find it expedient in any or most years to hold storage at the maximum stage so as to supplement the natural flow of the late winter as much as possible.

The United States computations were made on the assumption that the lake in any and most years may be held at the maximum limit of storage shown on drawing No. D-16 (later superseded by drawing No. F-239) throughout the entire storage period, and as is indicated to be the purpose of the company by the data in its drawings No. F-248 and Nos. S-89, S-90 and S-91. This called for the holding of the lake at 6 feet above the low water mark (i.e. at elevation 1,745·32) from the 1st of October to about the 7th January each year, and thereafter drawing the lake down uniformly until the commencement of the spring inflow. These latter computations do not take into account a hypothetical system of storage regulation to maintain certain flows, but assume that the company may at any and most times exercise the right of storage to the full limit specified in the application.

The results of the Canadian computations are recorded in table No. 1.

From this table the average backwater on Kootenay lake, at the international boundary, at Copeland, and at Bonners Ferry are recorded as follows:—

The average increased depth on *Kootenay lake* for the month of September will be 1·22 feet; for October, 2·80 feet; for November, 3·50 feet; for December, 4·17 feet; for January, 3·86 feet; for February, 2·73 feet; and for March, 1·04 feet (19 year means).

The average increased depth at the *international boundary,* for September will be 1·40 feet; for October, 2·81 feet; for November, 3·20 feet; for December, 3·65 feet; for January, 3·66 feet; for February, 2·69 feet; and for March, 1·02 feet (7 year means).

The average increased depth at *Copeland* for September will be 1·34 feet; for October, 2·55 feet; for November, 2·86 feet; for December, 3·57 feet; for January, 3·53 feet; for February, 2·60 feet; and for March, 0·94 feet (7 year means).

The average increased depth at *Bonners Ferry* for September will be 1·53 feet; for October, 3·30 feet; for November, 3·31 feet; for December, 3·78 feet; for January, 3·50 feet; for February, 2·22 feet; and for March, 0·74 feet (3 year means).

The average increased depth above the observed level for the seven month period would have been at Copeland, 3·17 feet in 1930-31 and 2·42 feet in 1931-32, and at Bonners Ferry 2·88 feet in 1930-31 and 2·17 feet in 1931-32.

The results of the United States computations are furnished with the statement of Mr. Davenport as previously noted. They show results for Kootenay lake, Port Hill (the international boundary), Copeland, Klockmann, and Bonners Ferry. The average backwater at Copeland and Bonners Ferry by months from September to March, inclusive for the years 1928 to 1932 is shown in table No. 2. The average backwater at Copeland and Bonners Ferry for the period is recorded as follows:—

The average increased depth above the natural level at Copeland for September would have been 2·14 feet; for October, 3·84 feet; for November, 4·60 feet; for December, 5·20 feet; for January, 5·07 feet; for February, 3·72 feet; and for March, 1·64 feet.

The average increased depth above the natural level at Bonners Ferry for September would have been 1·98 feet; for October, 3·54 feet; for November, 4·22 feet; for December, 4·84 feet; for January, 4·70 feet; for February, 3·32 feet; and for March, 1·41 feet.

The average increased depth above the observed level for the seven-month period would have been at Copeland, 3·84 feet in 1930-31 and 3·07 feet in 1931-32; and at Bonners Ferry 3·56 feet in 1930-31 and 2·79 feet in 1931-32.

As noted at an earlier stage in this memorandum the major portions of the differences in the results of the studies undertaken in the two offices are caused by the difference in the respective premises adopted. The Canadian computations are based upon the use of only so much storage in any season as is necessary to maintain the regulated flow required by the company in accordance with the program, as limited by storage lines Nos. 1 and 2 as laid down on its drawing No. D-16 (later superseded by drawing No. F-239) submitted to the International Joint Commission in support of its application. The United States computations are based on holding the lake at the highest permissible elevations throughout the storage season as shown by storage line No. 2 of drawing No. D-16 (later superseded by Drawing No. F-239).

Observations of ground water levels in the flats in Idaho were made by the United States Geological Survey through the low-water seasons of 1930-31 and 1931-32. Therefore the differences in results arising from this difference in premises become of interest in connection with studies of these seasons. In the following table is a comparison of the results obtained by the engineers of the Canadian and United States Governments as given in the above statements:—

TABLE NO. 3.—AVERAGE INCREASED DEPTHS DURING THE LOW-WATER SEASONS SEPTEMBER TO MARCH OF 1930-31 AND 1931-32

Low-water season	Copeland			Bonners Ferry		
	Canada	United States	Difference	Canada	United States	Difference
1930–31	3·17	3·84	0·67	2·88	3·56	0·68
1931–32	2·42	3·07	0·65	2·17	2·79	0·62

NOTE:—Depths for 1931-32 are above observed levels.

The average difference in the results in the seasons considered is approximately 0·65 foot, and this is attributed in large measure to the differences in premises above referred to.

Actual Conditions Resulting from the First Closure of the Corra Linn Dam in 1931. With respect to the actual effect on the levels of Kootenay lake and at the international boundary following the partial closure of the Corra Linn dam on October 11, 1931:—

It is agreed that following the partial closing of the gates, storage began to accumulate on the lake on or about October 14, reaching a maximum depth of practically 2 feet on December 16 to 18. (The United States computations show depths of 2 feet or slightly in excess thereof for about 15 days.) This storage on the lake caused a maximum rise in the neighbourhood of 1·7 feet Canadian result, and in the neighbourhood of 2·0 feet, United States result at Port Hill at the international boundary, and an average mean rise in the neighbourhood of 1·6 feet Canadian result and 1·9 feet United States result during the month of December.

It is agreed that following the opening of the Corra Linn dam on January 8 to allow free discharge, the stored water was completely withdrawn and the lake returned to its natural level not later and possibly a little earlier than March 23 —well before the spring inflow.

Effect of Diking on the Levels of Kootenay Lake and the Discharge Therefrom. With respect to the effect on the levels of Kootenay lake and on the discharge therefrom due to the diking of Drainage Districts Nos. 1 to 12, inclusive:—

It is agreed that the diking in question caused a raising of the water levels in Kootenay lake of probably not to exceed 0·15 foot at the peak of the 1932 flood. This raising would decrease progressively upstream and probably would be less than 0·1 foot at the international boundary.

It is agreed that since the discharge from the lake varies with the lake levels, the discharge would be increased or decreased proportionately with the lake levels as these were affected by the diking. This would have increased the discharge from the lake less than 1 per cent at the time of the 1932 peak.

Taking as an example the year 1916, a year of very high supply, and assuming that the above-named districts would have been successfully reclaimed from flooding and that the original lake outlet capacity applied, it was found in the Canadian computations that starting on 8th May there would have been a rise in lake levels, increasing to 0·64 foot on the 25th June, the lake returning to its natural elevation on the 13th September. This would have increased the discharge from the lake by 3·3 per cent at the time of the 1916 peak.

While daily records of the level of Kootenay lake throughout the high water of 1894 (the highest flood on record, when Kootenay lake rose 8 feet higher than in 1916) are not available, nevertheless, tentative computations made by the Dominion Water Power and Hydrometric Bureau, based on such data as there are available indicate that the loss in storage area due to the reclamation of Drainage Districts Nos. 1 to 12 in Idaho would have resulted in an increase in lake level very considerably greater than the 0·64 foot of 1916 (possibly totalling to $1\frac{1}{2}$ feet). The results in this and the next preceding paragraphs assume that the Idaho dikes would be raised to withstand flood waters like those of 1916 and 1894, which of course is not the present condition.

J. T. Johnston,
Director, Dominion Water Power and Hydrometric Bureau.

N. C. Grover,
Chief Hydraulic Engineer, United States Geological Survey.

TABLE NO. 1.—RESULTS OF CANADIAN COMPUTATIONS OF BACKWATER EFFECT OF STORAGE PROPOSALS OF THE WEST KOOTENAY POWER AND LIGHT COMPANY, LTD.

SUMMARY of Maximum, Minimum and Mean Monthly Storage Depths on *Kootenay Lake* during the *Nineteen Storage Seasons*, 1913 to 1932

—	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March
Maximum depths	2·15	4·01	5·09	5·37	4·74	3·36	2·03
Minimum "	0·00	0·00	0·00	1·41	2·51	1·34	0·01
Mean "	1·22	2·80	3·50	4·17	3·86	2·73	1·04

SUMMARY of Maximum, Minimum and Mean Monthly Storage Depths on the Kootenay River at *Port Hill* on the International Boundary during the *Seven Storage Seasons*, 1925 to 1932

—	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March
Maximum depths	1·93	3·79	4·84	5·04	4·71	2·99	1·43
Minimum "	0·00	0·00	0·00	1·18	2·15	1·72	0·21
Mean "	1·40	2·81	3·20	3·65	3·66	2·69	1·02

SUMMARY of Maximum, Minimum and Mean Monthly Storage Depths on the Kootenay River at *Copeland* during the *Seven Storage Seasons* 1925 to 1932

—	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March
Maximum depths	1·90	3·67	4·30	4·91	4·50	2·87	1·33
Minimum "	0·00	0·00	0·00	1·16	2·01	1·67	0·17
Mean "	1·34	2·55	2·86	3·57	3·53	2·60	0·94

SUMMARY of Maximum, Minimum and Mean Monthly Storage Depths on the Kootenay River at *Bonners Ferry* during the *Three Storage Seasons* 1929 to 1932

—	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March
Maximum depths	1·69	3·42	3·90	4·44	4·04	2·51	1·08
Minimum "	1·33	3·19	2·74	2·57	2·63	2·03	0·12
Mean "	1·53	3·30	3·31	3·78	3·50	2·22	0·74

NOTE:—The above means include results for 1931-32 for depths above the recorded levels, not the estimated natural levels.

TABLE NO. 2.—RESULTS OF UNITED STATES COMPUTATIONS

SUMMARY of Mean Monthly Storage Depths on Kootenay River at *Copeland*, 1929-1932

Year	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March
1928–29	1·96	3·00	3·80	4·65	4·80	3·70	1·90
1929–30	2·30	4·25	5·15	5·55	5·25	3·72	1·83
1930–31	1·88	3·90	4·70	5·35	5·37	3·65	2·00
1931–32	2·41	4·20	4·75	5·25	4·85	3·80	0·82
Mean	2·14	3·84	4·60	5·20	5·07	3·72	1·64

SUMMARY of Mean Monthly Storage Depths on Kootenay River at *Bonners Ferry*, 1929-32

Year	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March
1928–29	1·70	2·77	3·40	4·25	4·30	3·30	1·60
1929–30	2·20	3·90	4·90	5·20	5·00	3·30	1·60
1930–31	1·80	3·60	4·30	5·00	5·00	3·40	1·80
1931–32	2·20	3·90	4·30	4·90	4·50	3·30	0·65
Mean	1·98	3·54	4·22	4·84	4·70	3·32	1·41

NOTE.—The above results for 1931-32 are for depths above the estimated natural levels.

A. J. Matheson. The Senior Hydraulic Engineer of the Dominion Water Power and Hydrometric Bureau, made a statement supplementing the hydraulic studies embodied in the foregoing Joint Report, with particular reference to flood conditions in 1933. There was filed with the Commission at the same time a Memorandum of Mr. C. E. Webb, District Engineer of the Dominion Water Power and Hydrometric Bureau, together with a series of photographs illustrating high water conditions along the Kootenay river.

J. T. Johnston. Mr. Johnston filed a report embodying the substance of previous investigations relating to the development of the river, described as "A review of the More Important of the Many Investigations made by United States and Canadian Engineers, representing United States and Canadian Interests, Public and Private, including the United States Federal Government, the State of Idaho and the Province of British Columbia, who have made Field Studies into the Problem." This review, according to Mr. Johnston, "shows that these engineers had recommended, as one of the essential factors to successful reclamation, enlargement of the outlet of Kootenay lake. Several of these engineers have further recommended the construction of control works in the outlet to regulate the low-water levels." The investigations reviewed were those of A. S. Farwell in 1883, W. A. Baillie-Grohman in 1886, Otto Weile in 1905, H. F. Meurling in 1912, L. A. Jones and C. E. Ramser in 1915-16, W. G. Sloan in 1921, W. G. Swendsen and E. A. Cleveland in 1922, and Major John S. Butler in 1931.

International Considerations. Mr. Johnston in concluding his presentation said:—

"Before leaving this matter there is one other point that I meant to cover. In submitting this review of earlier investigations it is necessary to bring to the attention of the Commission the aspect of the larger international considerations which are involved in the problem now before the Commission. In making this review of past studies we gave consideration to the entire watershed and the marked international character of the river became very apparent. While the Commission has before it, at the present time, a specific problem—or rather two specific problems, having in mind the application in respect to the rehabilitation of the "Reclamation Farm" which comes on for hearing on the 26th—there is before the two countries the much larger problem of securing the best utilization of the waters of the Kootenay and Columbia rivers in the common interest of the United States and Canada.

"The Boundary Waters Treaty of 1909 was designed to insure the constructive utilization in the best and in the mutual interests of the High Contracting Parties of boundary waters and waters flowing across the boundary. The Treaty set up in the International Joint Commission the necessary machinery to realize this objective.

"The Kootenay river is probably the most outstanding example of an international stream along the entire boundary. It has its source in the eastern ranges of the Rocky mountains in Canada, flows south entering the United States at Newgate and for a distance of some 140 miles passes through the states of Montana and Idaho, re-entering Canada at Port Hill, flowing through Kootenay lake and entering the Columbia river which in turn recrosses the boundary and finds its way to the Pacific ocean through the state of Washington. All told, up to the point where the combined flow finally enters the United States, there has been collected the run-off from some 31,000 square miles in Canada and some 30,000 square miles in the United States.

"In order that the United States and Canada may realize the development of the full resources of this international river system, it is essential that there should be the fullest possible measure of mutual co-operation at all points. Any other policy can only prove mutually hurtful. Under the Boundary Waters Treaty, the High Contracting Parties have set up the necessary instrument to achieve this mutual co-operation.

"In the past several questions have arisen of an international character. One of these is the very important matter of diverting the water from the Upper Kootenay into the Upper Columbia. Another proposal which did not develop was the diversion of the Pend d'Oreille for the irrigation of the Columbia Basin project. That did not materialize because of opposition from different sections. At the present time there are two problems before the Commission. There are quite a number of difficult problems in connection with this watershed. It has been brought out that the storage of Kootenay lake is of substantial benefit to the development of power in the country to the south and further west. There are further natural reservoirs in Canada, and it is reasonably clear that some day there will be many power dams in the Lower Columbia river. There are many international features in relation to this watershed which will require the adjudication of this Commission, and, in the consideration of this present matter, I think it is very desirable to keep the general picture before our eyes and also to keep in mind the fact that mutual co-operation is necessary to secure the utmost mutual use of the resources of the watershed."

Power Benefits. Asked as to the potential benefit of the additional water proposed to be stored in Kootenay lake to the power resources of the Kootenay and Columbia rivers in Canada and the United States, Mr. Johnston said:—

"I have given consideration to it, but not in any intensive way. The general facts are readily apparent and readily understood.

"On the Kootenay river below Kootenay lake there are four developed power sites and one undeveloped site, making a total developed and developable head of 348 feet in Canada. The Kootenay river enters the Columbia river a short distance before the latter crosses the international boundary and enters the United States.

"On the Columbia river there is, according to United States Governmental reports, an available developable head of 1,300 feet in the United States. Of this head there is already developed some 50 feet at the Rock Island plant below Wenatchee, and there is being placed under way the development of some 355 feet at the Grand Coulee site by the Federal and State Governments in connection with the Columbia Basin Project.

"The beneficial value of the water stored in Kootenay lake will be available to Canada and the United States in proportion to the ratio of the respective heads in either country, i.e., the benefit to the United States would be nearly four times the benefit to Canada. It may be added that this benefit value to the United States is made available at no cost to that country."

Meek and Dawson Report. Mr. C. E. Webb filed with the Commission a report and accompanying volume of charts prepared by V. Meek and S. G. Dawson of the Dominion Water Power and Hydrometric Bureau embodying Ground Water Studies in Kootenay Flats. Mr. Webb explained that as a result of the request of the United States representatives that time should be allowed to study the effect of the storage proposals on ground water levels in the Kootenay Flats in Idaho, a series of three hundred wells were drilled at selected spots in the various districts south of the international boundary and a continuous record of the water table elevations in these wells was maintained, from the beginning of 1930 by the United States Geological Survey. The study prepared by Messrs. Meek and Dawson was for the purpose of determining the relationship existing between the ground water table of the drainage districts as indicated by the well records, and the adjacent water level in Kootenay river.

The report concludes with the following statements:—

" The following summary conclusions are drawn from the above studies of the water elevations of the wells in the cross-sections representative of each district in relation to the variations in river level, ground surface elevations, classes of subsoil and climatic conditions.

" The observation of the ground water elevations in the Kootenay valley, Idaho, from January, 1930, to September, 1932, covers a favourable period for studying the reactions of the water table under different climatic conditions and wide variations of river level. For two years prior to the observation period the seasons were reported dry with a deficiency of precipitation, resulting in subnormal seepage from the foothills and lower river levels. This condition continued to the fall of 1931 when it was practically reversed by a period of abnormal precipitation, resulting in almost flood conditions prevailing in the river during June, 1932.

" For the purposes of this study, the soils in Kootenay valley may be placed in two classes, the porous sandy soils, and the non-porous clay or peat soils. Invariably the land adjacent to the Kootenay river is composed of the porous sandy soils through which water may percolate more or less freely, while the land distant from the river and nearer the foothills consists of the clay subsoils through which the ground water movement is retarded.

" It will be noted from the cross-section of the valley plotted on each chart that the ground surface is highest near the river and slopes both ways to the lowest elevation near the foothills. In general the water table as indicated by the wells has a reverse slope and is highest near the foothills sloping to the wells near the river, which are affected by variations in rivers levels. This indicates that the main source of ground water in the valley is run-off and seepage from the foothills.

" The area in which the ground water table is affected by changes in river level is restricted to a more or less narrow strip adjacent to the river and varying in width from 200 to a maximum of 2,000 feet, evidently depending on the porosity of the soil and other physical conditions. For example, in District 9, which is sandy soil and practically surrounded by the river channel, the elevation of the water table in the whole district appears to be closely related to the river levels, whereas in District 10 in clay loam soil the river levels appear to affect the ground water table to a distance of not more than 400 feet from the river bank.

" The storage proposals in Kootenay lake will raise the natural level of the river during the low flow period an average maximum of slightly more than four feet and decrease materially the natural levels during the flood period—as shown on the charts." . . .

" In considering the possible effect of the backwater upon the water table and the relationship of such effect to crop production in the reclaimed area,

it is to be remembered that the storage period occurs after the crops are harvested and during the non-growing season of the year. In average years the storage period would extend from about September 1 to April 1. The proposed change from natural river levels as indicated on the charts consists of a gradual increase from zero in September to an average maximum of slightly over four feet in December, then a gradual decrease to zero again at the end of March. The average increase considering the storage period as a whole is therefore considerably less than four feet.

"It would therefore appear from this study of ground water levels from January, 1930, to September, 1932, that any higher water table which may result from the storage proposals in the area affected by seepage to or from the river will not have any injurious effect on the agricultural value of the land under consideration."

Fetterly Report on Soil Conditions. Mr. Webb also presented to the Commission a report prepared by P. A. Fetterly, Assistant Hydraulic Engineer of the Dominion Water Power and Hydrometric Bureau at Calgary, and engineer in charge of alkali investigations in the irrigation areas of southern Alberta and southern Saskatchewan. Mr. Fetterly had been instructed by his bureau to investigate soil conditions on both sides of the boundary in the Kootenay valley, giving special attention to the alkali content and to the possibility of alkali damage to the soil from changes in the water table elevation. (See Appendix P.)

The following are Mr. Fetterly's conclusions:—

"(*a*) The origin of the alluvial deposits in Kootenay valley would appear to indicate at the outset that sodium and magnesium salts should not be found in any great quantity in the valley. The higher masses consist of quartzites, argillites and dolomites. These contain very little harmful alkali salts.

"(*b*) Alkali is not present in the soils of either the Canadian or United States Kootenay valley in sufficient quantities, in the areas under consideration, to a depth of at least seven feet, to be harmful to the growth of crops. This conclusion was reached after a study of nearly four hundred samples. A criticism might be made that an insufficient number of samples were obtained for a general conclusion. The sixty-five locations, however, were carefully chosen from the areas nearest suspicion. The results of examining the whole area in detail, acre by acre, would probably make very little change. Any procedure even approximating the latter would obviously be impossible.

"(*c*) Even if the entire alkali content present within five feet of the surface were concentrated within the average root zone, no plant life could be injured by its presence. The evidence offered by soil tests from the deep wells on the United States side—some of them extending to a depth of thirty-two feet—indicates that no alkali in harmful quantities is present in the soils from seven feet to thirty-two feet at least. These conclusions are equally true on the Canadian side, as very little difference was noted between the soils on either side of the boundary. They are further substantiated by the results of chemical analyses and their known relations with bridge tests.

"(*d*) Should there have been alkali indigenous to the soil, most of it was leached out long ago by the movement of soil waters and carried away by country drainage.

"(*e*) The 'hoar-frost' effect, whatever may have been its origin, is so small in amount that it cannot under any circumstances prove injurious to the growth of plants. No authoritative explanation has been advanced for this condition. It may be due to the concentration of the minute amount of alkali present in the first foot or two of the soil under especially favourable conditions for its appearance, as it usually occurs in small areas of a hundred feet or so in diameter and then very infrequently, and is only present on the surface in a barely perceptible layer. The soil immediately beneath the first eighth- or

quarter-inch, used as the first sample in the group, is usually practically free from alkali. The skim samples, such as 27 A and 29 A, presage no danger of a rise of alkali or injury to crops. They are also found to consist largely of CA SO_4 and need not be seriously considered. No injurious or other effects on plant growth by the presence of alkali were noted in any portion of the valley.

"(*f*) There can be no doubt but that the raising of the water-table in the winter will not have any effect on any possible content of alkali. A further proof of this statement is the present surface condition of the soil.

"(*g*) No alkali is present in any of the water samples to the least injurious extent. The largest amount found in any water sample was 0·07 per cent by weight. Evidently very little alkali is left in the valley, if it were ever present in large amounts, to be carried by the river.

"(*h*) A numerical analysis of bridge results of testing for alkali-content on both the Canadian and United States sides of the boundary, for each separate depth, as given in Appendix 5, indicates in graphical form the paucity of alkali present in the soils.

"(*i*) The results of chemical analysis corroborate the bridge results but in a more exact and authoritative manner. The exact harmful salt content is now known. This was an unknown quantity before the chemical analyses were completed. These indicate that the bridge results comprise a fair indication of the amount of injurious salts present in soils.

"(*j*) It would seem from a study of bridge and chemical data that the present conditions would indicate no detrimental effects from the alkali salts (with the possible exception of 'No. 27 A skim' and 'No. 29 A skim') which are dealt with above in (*e*).

"(*k*) It is just possible that the toxic condition of the peat samples are less serious even than is indicated by the bridge tests or chemical analysis.

"(*l*) The greater portion of the salts consists of calcium sulphate with very small quantities of sodium sulphate as a rule. Calcium sulphate, although it has nearly the same resistance as sodium sulphate, is only two per cent soluble in water, while sodium and magnesium sulphates are about forty per cent soluble. Calcium sulphate is not nearly so toxic as sodium sulphate. The bridge tests indicate less salts than are actually present, although this statement does not affect the general conclusions, the actual salt-content being still small.

"(*m*) The alkali carbonates are present in the soil solution in the form of bi-carbonate, and are very small in amount.

"(*n*) The favourable appearance of crops in all parts of the valley would appear to corroborate the bridge tests and chemical analysis.

"(*o*) Seepage water was noted at many points on both sides of the valley, near the top of the slopes. This water, whether originating under a false bedrock as mentioned under District 1, 'seepage,' in the hills or, remotely, from the creeks, undoubtedly has the effect of raising the water table. Certain evidence partially supports the false bedrock theory of origin of the seepage water around the edge of the flat. The amount of water delivered by this seepage is impossible to compute but the aggregate must be very large throughout the valley.

"(*p*) No didactic statements can be made in this report regarding the relations between the elevations of water-table and river. A study of well data over a period of time is necessary before this can be done. An inspection of the river banks when the water is low would assist to this end. Statements regarding 'lag' of water-table in this report are tentative, as that question is mostly outside its province, isolated wells and group locations only having been inspected. However, during the period of inspection several wells were known to indicate a drop in water-table level.

"(*q*) The safe minimum depth of water-table for the growth of plants lies between four and six feet during the latter part of the growing season, the former being considered as effective and the latter safe."

Department of Indian Affairs, Canada. Mr. J. T. Johnston presented a statement embodying the views of the Department of Indian Affairs of Canada in regard to the application. He pointed out that there were eight Indian reserves on the Kootenay flats in Canada, and that the department therefore had a very vital interest in the proposals. The attitude of the department, as approved by the Deputy Superintendent General of Indian Affairs, is as follows:—

"The Department of Indian Affairs is prepared to accept the analysis of the effect of the company's proposals upon the water levels of Kootenay river and lake as prepared by the technical officers of the Department of the Interior, and as submitted to the Commission yesterday.

"The Department of Indian Affairs does not consider that the moderate backing up of the Kootenay river water level at the international boundary as indicated by the results of investigations made by engineers of the Dominion Government and filed with the International Joint Commission in connection with the Power Company's application, i.e., an average backing up of 1·40 feet in September, 2·81 feet in October, 3·20 feet in November, 3·65 feet in December, 3·66 feet in January, 2·69 feet in February and 1·02 feet in March, will in any wise injuriously affect the Indian lands on the Kootenay Flats.

"On the other hand, the department appreciates the benefit that will accrue to these lands by the reduction of the high water stages of Kootenay lake and river as indicated by the results of the aforementioned investigations.

"The Department of Indian Affairs is therefore prepared to concur in the approval of the Company's proposals as submitted to the Commission."

Department of Public Works, Canada. Mr. W. E. Keyt, Acting District Engineer of the Department of Public Works of Canada, presented the views of that department. He said: "I may state that there is nothing in the scheme which injuriously affects navigation (that being the primary interest of the Department in the case). Low water conditions are improved for us, thereby eliminating certain dredging which in the past we have had to do. High water conditions affect our structures. We have built and are maintaining about twenty wharves in this district. They have been designed and built for high water conditions. Anything that will alleviate these conditions is favourable to us. We have no objection whatsoever to the scheme."

Attorney-General of State of Idaho. Mr. Bert H. Miller, Attorney-General of the State of Idaho, gave his views as to the effect of the proposed works upon interests in Idaho, and also as to certain points of interpretation of the Treaty under which the Commission functions. He quoted the statement in the Amended Application to the effect that in the opinion of the applicant company their proposed works "will not have any injurious effect on any interests in the United States or any State thereof," and also the Reply of the State of Idaho denying this allegation. He submitted "that when the applicant made its application for permission to store certain waters it was then incumbent, and is yet incumbent upon the applicant to prove not only beyond a reasonable doubt but beyond the question of any peradventure of a doubt, that in seeking the thing it seeks to do no injurious effects or results will attend the granting of what it seeks to do."

In reply to a question by Mr. Stanley as to whether or not the Attorney-General was arguing that it was beyond the power of the Commission under the Treaty to authorize any permanent changes in levels of the waters flowing across the boundary, Mr. Miller replied: "Absolutely, you have my position correctly." He also quoted in support of this contention the language of the Protocol attached to the Treaty: "Nothing in this Treaty shall be construed to interfere with the drainage of wet, swamp, and overflowed lands into streams flowing into boundary waters."

The Attorney-General also argued that Drainage Districts were primarily created under the law of Idaho as a sanitary measure, and that under the Treaty sanitary uses stand first in the order of precedence. His view was that these Idaho lands were probably the most fertile within the United States. It was incumbent upon the Applicant to prove that this land would not be injured by the proposed works. The applicant has not made even a *prima facie* case, much less demonstrated beyond a question of doubt that the granting of permission to store six feet of water in Kootenay lake will have no injurious effect upon the land-owners of the various Drainage Districts involved."

Asked by Mr. Stanley how he construed the language of Article VIII of the Treaty " in cases involving the elevation of the natural level of waters on either side of the line as a result of the construction or maintenance on the other side of remedial or protective works or dams or other obstructions in boundary waters or in waters flowing therefrom or in waters below the boundary in rivers flowing across the boundary, the Commission shall require, as a condition of its approval thereof, that suitable and adequate provision, approved by it, be made for the protection and indemnity of all interests on the other side of the line which may be injured thereby." Mr. Miller replied:—

" I place this construction upon it, just as I did in the first instance. Changes in which the Canadian Government itself may be interested may come about but not those initiated by private interests. That is the construction I place upon the Treaty. There may be changes. If there were changes affecting private interests, initiated and carried out by Governmental activities, this Commission would have the right to make an award and determine the compensation, but the Commission cannot act or function in so far as private interests are concerned and bring about a changed condition from normal or natural conditions."

Mr. Crowe drew the attention of the Commission to paragraph 9 of the Response of Idaho to the Amended Application, wherein the Attorney-General and O. C. Wilson " admit that the consent of the International Joint Commission is necessary to the construction and operation of the said dam as a storage dam under and pursuant to Article IV of the Treaty of January 11, 1909, between the United States of America and Great Britain."

Guy C. McGee, for the State of Idaho. Mr. McGee quoted from and commented upon the report prepared by him and filed with the Commission on " Kootenai Valley Flood Control ". He said: " It is a report on an investigation taking into consideration the data furnished by the United States Geological Survey, the United States Department of Agriculture, information which is on file in the office of the Commissioner of Reclamation of the State of Idaho, my own personal observations during eight years of work in the Kootenai valley; it is a brief description of all this information together with a more or less detailed account of the results that may be obtained if this storage application is allowed."

Mr. McGee quoted from p. 40 of the report which embodied a summation of the results anticipated if the application was allowed:—

" From the surveys and studies made, consideration of all available data and information obtainable, and my personal knowledge and acquaintance with conditions on the ground, I believe that the proposed regulation and control of Kootenai river would be unreasonable, unjust and a menace to the interests of the land owners in the several Drainage Districts in the Kootenai valley between Bonners Ferry and the Canadian line and would result in irreparable injury to them, on which account I feel the application for approval of works on the Kootenai river and for the right to store water in the Kootenai lake should be denied."

A statement was quoted expressing the concurrence, in the above opinion, of Mr. R. W. Faris, Commissioner of Reclamation for the State of Idaho.

Questioned by the Attorney-General as to the effect on the sluices of storing six feet of water in Kootenay lake, Mr. McGee said:—

"It would raise the water approximately three and seven-tenths feet, taking the average of the elevations of the water for 1931 and 1932. . . . Four of the Drainage Districts would be materially affected, numbers 1, 7, 6 and 11. . . . It would increase the seepage condition of the river and cause the owners to pump additional water. During the greater portion of the year it would require that they have a continuous observation of these outlet sluices so that fluctuation in the river itself may not be detrimental or damaging. . . . The expense of pumping would be very materially increased. . . . By the raising of the water plane during the winter months, seepage would occur along the dike areas during that period of time building up a higher water plane close to and extending back into the district. That is the period of time during which our land drains out naturally through the river. If this higher water plane is maintained a barrier will result in the land retarding to a great extent drainage of the land by raising the gradient of the underground water. When the break-up would come in February and March, at which time the water gets quickly to the water table, it would back up affecting all of the land in all of the districts. The results of these studies are given in tables in this Report showing the averages for 1930, 1931 and 1932 and the increased area that would be affected for each particular district, the amount of that effect and the increased area of the water plane within an injurious distance of the surface."

Asked what effect that would have upon productivity, Mr. McGee quoted the conclusions of his report on page 5:—

"The underground reservoir would be filled with seepage and percolating water to such a height as to deprive the lands within the drainage districts affected of a sufficient reservoir to take up the spring run-off and precipitation, thereby raising the high water table to a point, and at a time of the year when farming operations are in progress, that would completely destroy a total of 9,431 acres and seriously impair the value of 4,919 additional acres of the lands in the valley. The effect of this would be to take away the ability of the districts to raise sufficient crops to pay their outstanding obligations, their maintenance and operation costs and to leave no return to the farmers, which would necessarily result in the abandonment of all the affected land, increase the taxes on other taxable property within the county, decrease the taxes collected by the state, and reduce the income to the railroads and other public utilities, thus seriously affecting all business within the county."

R. W. Davenport, U.S. Geological Survey. Mr. Davenport described the extent and character of the investigation conducted by the Geological Survey since 1928. The investigations were carried out by various officers under the general direction of N. C. Grover, Chief Hydraulic Engineer. They included the securing of records of stage and flow of the Kootenay river and tributaries and the preparation of a detailed topographic map of the valley. This was done before the filing of the application of the West Kootenay Power and Light Company. Thereafter studies were made of ground water conditions in the flat agricultural lands in the valley for the purpose of appraising possible effects thereon by the raising of the water levels in connection with storage operations. Money was contributed both by the company and the state of Idaho to facilitate the work. Arrangements were made for the participation of a Bureau of the Department of Agriculture in an investigation to determine the practical effect of the company's proposals on crop production. Mr. Davenport had himself analysed the proposals of the company with the object of determining the effect on water levels of the river in Idaho both as respects the lowering due to the proposed Grohman improvements and the raising due to the proposed storage on Kootenay lake.

Mr. Davenport then explained the scope of the statement filed with the commission on behalf of the United States Geological Survey, as to the effect of the proposals of the company on the Kootenay river in Idaho. After discussing the floods of 1894 and 1916, and the less serious floods of 1903, 1913, 1927 and 1928, Mr. Davenport quoted the following from the report:—

" To summarize this analysis of past floods, it may be concluded that once in twenty years on the average there has been a flood in which there would have been great damage irrespective of any possible lowering by the proposed Grohman improvement. Once in 20 years on the average there has been a flood the lowering of which by one to two feet might have materially reduced the loss and damage. In eighteen out of twenty years the prevention of flood loss by the Grohman improvement would have been relatively insignificant, although it would have resulted in some reduction of seepage into the drainage districts and in decrease in pumping heads during the flood periods.

" This general conclusion as to the experience with the floods of thirty-nine years past is the best possible prophecy of what is likely to occur in the future. However, the following reservation must be made. If diking in the United States and Canada should continue beyond that now in effect, flood levels will be further raised. The result might be to place floods like those of 1903 and 1913 and possibly those of 1927 and 1928 in the class of those of 1894 and 1916 in causing damage which it might be beyond the limits of feasibility to prevent by the Grohman improvement. Thus the number of years out of twenty in which great loss would be practically unavoidable might be increased from one to two or three. On the other hand, it must be recognized that with the passage of time dikes will probably be improved so that they will be progressively effective in protection against higher and higher floods. Nevertheless, even with these considerations taken into account, it is believed to be a reasonably reliable prediction that there would still be about one flood in twenty years the damage from which could be at least greatly diminished by a lowering of one to two feet in flood heights by the Grohman improvement."

Asked as to the effect of the completion of the dikes at Creston and in connection with the Kootenay farm upon the run-off of Kootenay river above the improvements, Mr. Davenport said: " The effect would be to increase the levels in Idaho. For a flood like that of 1927 I estimate an average of about one foot in the Idaho portion of the river up to Bonners Ferry."

" Mr. Stanley. In other words, the improvement of Grohman narrows would neutralize the condition of the river between Grohman narrows and the flats in the United States."

" Mr. Davenport. To a considerable measure."

Thomas R. Newell, U.S. Geological Survey. Mr. Newell said that the work he had been engaged upon consisted mainly of the collection and computation of stream flow data and special field investigations, and office studies relating to the Kootenay river.

In reply to a question as to the effect of the proposed storage on the water levels in Idaho, Mr. Newell said that storage in Kootenay lake would usually begin to be accumulated in August, and would be continued until a maximum of six feet was impounded in the lake several months later; storage would then be drawn off in January, February and March to augment the natural outflow of Kootenay lake. In general the proposed lake levels would be from nothing to six feet higher than the natural from September to March inclusive. Corresponding river stages in Idaho would be nothing to five feet higher than natural from September to March inclusive. The average equivalent of the increase for the seven months period would be 2·8 to 3·8 feet.

Mr. Newell filed an Exhibit showing the effect of the proposed storage. (Newell Exhibit No. 1.)

He gave the area of Districts 1 and 3 to 13 inclusive as 31,000 acres; District 2 and unreclaimed areas, 8,000 acres, making a total of 39,000 in the Idaho section of the valley, the adjacent British Columbia section being 37,400 acres.

Describing the character of the land, Mr. Newell said:—

" The lands along Kootenai river have been built up largely by deposition of sediments brought down by the river and by tributary streams. The lands nearest the river and tributary streams are higher than those farther back and adjacent to the foot-hills. These lower lands are particularly fertile and receive the rain and snow water running from the adjacent higher areas. Curves of area versus elevation have been prepared for each district and for the valley as a whole. They show the acreage at different elevations between the lowest and the highest. The belt of high ground along the river banks slopes back to the low ground near the foot-hills. During the proposed storage period the water tables are naturally higher near the foot-hills. The ground surface slopes towards the foot-hills and the water table slopes towards the river. This means that the margin of space between the water table and ground surface in the low back areas is very small."

Mr. Newell said that the field investigation carried out under his direction comprehended three activities:—

(1) the collection and compilation of stream flow data, begun in 1928.

(2) the collection and compilation of records of ground water, climate and drainage, begun in 1930.

(3) the periodical inspection of Corra Linn dam operation, begun in 1932.

Mr. Newell filed a series of exhibits, eleven in all, covering the basic data and dependent studies. He described the methods employed in making ground water studies, and the method of installation and observation of wells, also the drainage and diking system.

Taking District No. 7 as an example, he explained the ground water conditions, the general relationship between river levels and water table, and the application of the data collected to the general purpose of the investigation. Special attention was given to what are called " critical areas," or those in which the water table was within four feet or less of the ground surface on April 1, 1930. The importance is emphasized of any proposed increase in water table elevation to these areas. They might be affected adversely if increases in water table height result from the proposed storage because the present margin of space below the ground surface even at planting time is small. He emphasized the importance to areas of considerable magnitude of any proposal which might increase the height of the water in the late winter and spring.

Mr. Newell, referring to the second chapter of his report (Newell Exhibit No. 9) said that it illustrated the general relationship between river levels and water table, and explained the agencies other than the river which affected the height of the water table throughout the season.

Asked to name and describe the agencies other than the river which affected the water table in critical areas, Mr. Newell said:—

" I have noticed six agencies other than the river which may affect water table elevations:—

(1) Rain and snow falling upon the land percolate to the water table, causing it to rise.

(2) Water from melting snows flows down the mountain sides onto the lands or may concentrate from higher district lands adjacent and then percolates to the water table in the same manner.

(3) Ground water percolates from tributary stream beds or from adjacent mountain lands to the water table in these lower areas.

(4) Drain ditches draw away the ground water and cause the water table to fall.

(5) Evaporation from ground surface draws water from the ground and thereby lowers the water table.

(6) Vegetation absorbs large quantities of ground water from the water table to be transpired or consumed in plant growth.

" Mr. Metzger. If there were no other agencies except the river to affect the water table in Kootenay valley lands, at what elevation would we expect to find the water table? I mean by this, to conceive that the river is flowing as usual by Bonners Ferry and that below that point the adjacent lands are not affected by other agencies as tributary streams, drain ditches, rain, snow, side hill or deep percolation, evaporation or transpiration.

" Mr. Newell. Under this condition, if the river remained at one level the year round, the water table would become established practically at that level. If the river rose in summer as it now does, the water would tend to rise during the summer. If the river fell to lower levels in the winter, as it now does, the water would seep back from the land to the river, and the water table would tend to fall during the winter. It is axiomatic that water seeks its level, and that when the river is above the water table the ground water movement would be from the river to the land, and when the water table is above the river, the movement would be from the land to the river.

" Mr. Metzger. When the river rises rapidly as in the spring floods, the river level may be considerably above the ground water level. Does the magnitude of this difference in level affect the rate of movement of water between the river and the land?

" Mr. Newell. It is a well established principle of ground water movement that the rate of flow through given soil materials varies directly with the difference in level of the water at the beginning and end of the course of flow considered. It is evident from this that the rate of flow from the river to the water table at a given point would tend to vary this directly with the difference in the two levels and the greater such difference the greater would be the movement of the water from the river to the land.

" Mr. Metzger. What would you say of the reverse condition when the river is below the water table?

" Mr. Newell. The rate of flow from the land to the river would vary with the difference in elevation between the water table and the river. If the difference in elevation were increased the flow would increase; if it were reduced as by raising the river levels in the winter, the rate of seepage from the water table to the river would be reduced also.

" Mr. Metzger. In general, therefore, there would be movement of water from the river to the land when the river was above the water table and from the land to the river under the reverse condition?

" Mr. Newell. Yes. It may also be pointed out that the quantity of water moving from river to land or from land to river would vary with the length of time during which the particular process was in effect. Therefore, the amount of seepage to the river depends not only on the head between the water table and the river, but on the length of time which it prevails.

" Mr. Metzger. Summarize and give your reasons for believing that a relationship exists between river level and water table.

" Mr. Newell. The most important reason for believing that a relationship exists is a belief in a fundamental law of hydraulics—' Water tends to seek its own level.' To negative the operation of this law would assume the conception that Kootenay river flowed through a water-tight trough in its journey through Kootenay valley.

"Other agencies affecting the water table by adding to or taking away from ground water supplies may obscure the river effect but movement to and from the river is constantly taking place.

"Illustrations of the movements of ground water through the valley soils are found in Chapter 2.

"First, rate of recharge of observation wells, page 15.

"Second, pictures of 'Boil' flow, pages 17 and 18.

"Third, examples of pressure wells, page 19.

"Fourth, rate of 'Boil' discharge, pages 20 and 21.

"Fifth, quantities pumped, 1930, 1931 and 1932, page 22.

Mr. Newell added that the third chapter of his report was an application of the ground water data collected in District No. 7's critical areas to prove the relationship between river level and water table and to evaluate the rate of seepage from river to land and land to river.

He also filed a memorandum giving similar data for District No. 4, and explained that he had selected this district because it was on the opposite side of the river and farther down the valley. The surface soil in the critical area there was predominantly peat rather than silt.

Asked if he was prepared to show the results of his studies in other districts, Mr. Newell said that a report had been prepared to present comparatively the effects of higher river levels on water table and drainage outlets. Copies of this report were filed with the Commission as Newell Exhibit No. 11.

L. T. Jessup, U.S. Department of Agriculture. Mr. Jessup said that he had been working on the Kootenay investigation as a drainage engineer since the spring of 1930. He testified as to the time and extent to which the operation of the dam would affect water levels in Idaho. The chief object of his investigation was to determine the upper limit at which the water table could be maintained before crop production and yield would begin to be reduced. He supplied Mr. Newell with soil moisture data and evapo-transpiration data; made each year a complete map of the Kootenay valley and numerous studies and experiments relative to the physical properties of soils in the valley; also studied the relation between yield and depth to water table. He described the method employed in making his studies. He mentioned that a considerable part of the Kootenay valley consisted of organic soil, meaning peat, containing large amounts of vegetable matter. Perhaps about one-third of the entire valley was that class of soil. The remainder was classed as mineral soil, which included such types as silver clay loam and in some instances sandy loam and silt loam.

Rufus Woods, Columbia Basin Commission. Mr. Woods explained the history of the project for the development at the Grand Coulee dam on the Columbia river, and the importance of combining it with storage development on the British Columbia side.

O. C. Wilson. Mr. O. C. Wilson of Bonners Ferry introduced a number of witnesses who wished to give testimony as to the effect of the applicant's proposal on their properties.

Idaho Farmers. J. J. Whitton of Boundary County, Idaho, testified as to the condition of the Kootenay river in 1933. He said:—

"We had a higher water table this spring than we have had at any time since I have been farming in there and the result of that water table on our low land was that the lands stayed wet. We could not get on them. There is acreage in most of these districts that we are unable to put under crop at all owing to the fact that we could not get on the ground, and a lot of the low land we were able to get on was gotten on so late in the growing season that we ran an awful chance of the crop being spoiled with the frost. It seems to

me to be due to one thing only, that during previous winters we had a low water level all along our river banks and down at the stage of the river the water would be running out of districts, seeping out, and the land would dry in spring early enough so that we could get on it.

"This spring we experienced a different condition. The water was high and we had to start our pumps earlier than we did before and we were not able to get on the land, some of it, due to the fact that water from the hills must have failed to drain out. If the water in the river is just a little bit too high it will hold the water in the low ground high enough to keep the low land wet."

Similar testimony was offered by E. J. East of Bonners Ferry, Theodore Gieszelmann of Boundary County, E. Desvoigne of District 4, George Irving of Bonners Ferry, George E. Crocker of Boundary County, Simon McDonald of District No. 1, J. H. Booher of the same district, Oliver H. Campbell of the same district.

In answer to a question as to the desirability of a lower flood level of the Kootenay river in summer time, Mr. Irving said:—

"I am not as much afraid of the high water as I am of the water stored in upon us. We can protect ourselves against high water if we get money enough, but if there is any damage done to us at low water we can get no relief from that. . . . I believe we could control the high water with our dikes, and we do not need to control the low water if it is left as it is naturally."

Asked what his observation showed would be the effect upon farming operations in years such as 1932 and 1933 when the water in the river remained high during the low water period, as compared with conditions which would exist when the water would be at approximately zero during the same period, Mr. Desvoigne said: "When the water in the river remains at zero you got on your land earlier in the spring, you got your crop in earlier and you did not have to pump early in the spring. In those two years the river was higher and we had a great deal of trouble getting on the ground; in fact we could not get on the ground until later and pumping was more expensive."

Charles Ennis testified as to the source of seepage, the value of land and the effect of the applicant's project. He also filed protests of his wife, Isabella Wigley Ennis, John Davidson of Bonners Ferry, J. H. Guthrie of District No. 6, J. H. Cave of Drainage District No. 1. Patrick H. Walker submitted a written statement of E. J. Doyle of Bonners Ferry, protesting against the works of the applicant.

A. Klockmann of Bonners Ferry said that he could not quite agree with all the statements that had been made by his friends and associates in the Kootenay valley. He said that there were nine districts that could not possibly be affected by the proposed works. His district was one of the nine. Asked if he thought the seepage hurt any of his land he replied: "Not in our nine districts, but I do think so in perhaps Number 1 District and in others. But it does not hurt the majority of the districts, and as compared to that I am personally fully convinced that the benefit of reducing the flood will far offset the other."

Asked by one of the commissioners why the improvements proposed could not injuriously affect nine districts, Mr. Klockmann replied: "For the simple reason that they (the company) only intend to raise the water six feet. In my case if they raise that water six feet and I do not have to close my sluice gates until the water in the river is twelve feet, how could that six feet affect me? The nearer the water comes to the surface, the better the crops. This year is an illustration of that. The water in my district was one foot, and I had the biggest harvest that the country ever saw. People came down there looking at it. We had a yield of wheat from 75 down to 50 bushels per acre."

L. T. Jessup Recalled. Discussed a series of tables in his report and pointed out that they were not conclusions but simply designed to show what would happen if the water table had been raised one foot or two feet, and what the changes in yield would be in the critical areas of the various drainage districts.

G. E. Clark, United States Indian Service. Mr. Clark testified that there were 2,600 acres of land in Drainage Districts 3, 6, 7, 11, 12 and 13 held in trust by the United States Government for the benefit of its incompetent Indian wards, and that the Government had spent $114,000 in reclaiming these Indian lands. "It is evident," he said, "that if by raising the underground water level these lands cannot be leased to those who will cultivate them, the Government stands to lose a substantial sum by reason of this appropriation and failure to have the same reimbursed to the Government. . . . . It is the position of the Indian Service in regard to these leases (Indian lands are generally leased to farmers) that there will be a distinct disadvantage to the Indians and to the United States by raising the underground water level. There is a certain amount of underground storage which takes care of the early floods by reason of drainage throughout the fall and winter months into the Kootenay river. This underground storage can take care of early floods and that space will be available unless the river stage and underground stage are kept at higher level throughout the fall and winter months." Mr. Clark filed a statement showing the acreage of Indian lands and the investment of the United States in their reclamation. (Clark Exhibit No. 1.)

Boundary County. Patrick H. Walker, Counsel for Boundary County, Idaho, filed a statement (Idaho Exhibit No. 7) in which he considered the effect of the proposed storage upon lands in Boundary County in relation to taxation.

Sherwood Lett, Vancouver. Mr. Lett as representing the Alberta and British Columbia Exploration Company and trustee in bankruptcy of the Kootenay Valley Power and Development Company, said that he appeared for the purpose of withdrawing the objections made to the application by the interests he represented.

R. C. Crowe, Closing Statement. Mr. Crowe in closing the case for the Applicant said:—

"The Power Company, either by its application or in my statement, removing any confusion that may have arisen in the terms thereof, is applying to this Commission for the approval of the works set forth in its application, and consisting of the operation of a dam already built at Corra Linn on Kootenay river in such a manner that storage of water may be obtained in Kootenay lake and river in the following manner:—

"To effect the storage by first permitting the passage of the normal seasonal high flow in the spring and summer months, and by partially closing the sluice gates in the dam when the water in Kootenay lake at Nelson reaches a stage approximately 4 feet (that is elevation 1743·32 Geodetic Survey of Canada datum, 1928) above the average low water mark; and then, after the 31st of August each year by allowing the lake to rise slowly until it has reached a stage on the main lake of six feet above the average low water mark at the end of September (that is elevation 1745·32). By control from Corra Linn dam the main lake would be held not higher than this elevation, but would be drawn down during the low water months as required for power,

or to fulfil the following conditions: The main lake elevation would not be higher than elevation 1744 on the 1st of February, 1742·4 on the 1st of March and 1740·8 on the 1st of April if the storage season does not terminate before this date, due to the annual flood rise.

"In order to be able to accomplish this and particularly to see that the level of Kootenay lake is reduced to said average low water mark at the time mentioned, so as not to have any backwater effect in Kootenay lake, when the spring freshet comes, the West Kootenay Power and Light Company has already enlarged the channel of Kootenay river from Granite to Corra Linn dam and proposes if this Application is granted, to enlarge the channel of Grohman Narrows by excavating therefrom 250,000 cubic yards of material. It has been suggested in one of the reports submitted that the Power Company might not be able to do this in certain years when on account of weather conditions there should be an early freshet. Our company is therefore willing to undertake that if, in the operation of the storage scheme, it is found that 250,000 cubic yards from Grohman narrows is not sufficient, to excavate such additional yardage as would insure that the result mentioned by me can be substantially accomplished, and that only the most abnormal conditions will prevent it.

"It has been established by evidence submitted by ourselves, by Mr. J. T. Johnston, Director of the Dominion Water Power and Hydrometric Bureau, and by Mr. N. C. Grover, Chief Hydraulic Engineer of the Federal Government of the United States (U.S. Geological Survey), that the work done and proposed to be done will not increase the flood level of Kootenay river in Idaho, but will on the other hand decrease that level which, I respectfully submit, is a benefit that must accrue to the State of Idaho, and has been so proven and admitted although attempts have been made to mitigate it. Differences have appeared as to the extent of the lowering of flood water levels, depending largely upon whether it was assumed by the party making the computation that the Power Company would serve its own interests to the greatest advantage without consideration of other parties, and assuming extreme or average conditions as to the flow that might occur in the river.

"The Power Company is confident that its computations will meet much more than the average conditions that will prevail, this confidence being based upon many years of experience in the building and operation of power plants on Kootenay river; and I, on behalf of that Power Company have no hesitation in saying that, as a public utility of the Province of British Columbia, wishing to live as a friendly neighbour with the subjects of the United States to the south of us, it will do all reasonably within its power to prevent injury to anyone, and will, therefore, have all interests in mind when operating this dam.

"This, however, need not be taken as the only guarantee, because the engineers advising this Honourable Commission will be available to advise them as to what rules and procedure could be adopted to effect this end.

"We have, I respectfully submit, shown that with regard to the reclamation districts in Idaho who have made the most serious objection before you, at least nine or ten of the affected districts will not be in the slightest degree deleteriously affected by the higher elevations of Kootenay river that will occur during the storage period, lasting from September 1 to on or about April 1, but will reap all the benefits therefrom and which, I submit, are substantial.

"To a considerable extent this statement likewise has been confirmed by evidence submitted by Mr. Metzger, Counsel for the State Department of the United States, and by Idaho interests. Probably some differences have appeared with regard to the evidence respecting the remaining Districts, namely, Numbers 8, 6, 11, 7 and 1.

"With regard to Districts Numbers 8, 11 and 7, I am confident a proper perusal of the evidence would show that either there will be no damage, or that the benefits to accrue would overbalance said damage, but I will not say that this is an admitted fact unless it should be with regard to District No. 8.

"With regard to Districts No. 1 and No. 6, I would say there is substantial evidence that no balance of injury over benefit will accrue. We have heard several witnesses from the State of Idaho frankly say they have no great interest in the flood level, but fear rather the increase in level during the winter months. With all due respect to them, and realizing that they are not able properly or fully to understand the meaning of how this scheme will work out, I think they have rather understated their concern about flood levels. The preponderance of evidence has been to the effect that they fear the raising of the water table in their land, in consequence of seepage water about May 1, their sowing time. I do not think that most of them have realized that at this time of the year our works will result in a decrease in the river level over its natural condition, and that therefore their condition at that time should be improved rather than hurt. If that should not be substantial, it is a question of doing more pumping at that time of the year than has been done in the past, and if this is the question surely we are entitled to the credit of causing them less pumping in the spring and summer months in consequence not only of the lower level of the flood peak, but of the lowered level that will ensue from on or about the 1st of April right up until the peak of the flood; and the greater lowering of level that will ensue to them after the peak flood.

"Also it must be remembered on this same account, that the result of this is to leave uncovered the outlets of their drainage sluices for a longer period after the 1st of April than would otherwise have been the case, during which longer period natural drainage would be possible."

Briefs. The Commission at the close of the hearing gave the applicants two months in which to file a Brief, and the Governments of the United States and Canada and the State of Idaho, two additional months to file their briefs.

On January 10, 1934, the West Kootenay Power and Light Company, Limited, filed a printed Brief with the Commission.

A Brief on behalf of the Government of the Dominion of Canada was filed on January 11, 1934.

Under date of March 7, 1934, the Government of the United States filed a Brief in Reply to the Brief of the West Kootenay Power and Light Company, Limited, and the Brief of the Government of Canada.

On March 21, 1934, the State of Idaho and Drainage Districts Numbers 1 to 4 inclusive and 6 to 13 inclusive of the County of Boundary in the State of Idaho, also filed a Brief in Reply to the Briefs of the Applicant and of Canada.

Exhibits. A list of the Exhibits filed at this hearing on behalf of the Government of Canada, the Government of the United States, the State of Idaho, and the West Kootenay Power and Light Company, Ltd., will be found in Appendix R.

Final Arguments. At an executive session held in Washington on April 6, 1934, the Commission decided to hear final arguments in the matter of the Application of the West Kootenay Power and Light Company at the regular meeting in Ottawa in October, 1934. On the conclusion of the oral arguments the Commission would proceed to consider its order.

Reply Briefs. On October 2, 1934, a Reply Brief was filed on behalf of the West Kootenay Power and Light Company, Limited; and on the same day a Reply Brief on behalf of the Government of Canada.

Summaries of Briefs. As it was not found practicable to publish the various Briefs in full, Counsel for the West Kootenay Power and Light Company, the Government of Canada, and the Government of the United States were asked to submit summaries, which follow. The Brief submitted on behalf of the State of Idaho and of the Drainage Districts, filed with the Commission March 21, 1934, did not lend itself to summarization and is therefore printed in full.

Summary of Brief of West Kootenay Power and Light Company Limited

The Amended Application. Under and pursuant to Article IV of the Treaty of January 11, 1909, between the United States and Great Britain, the West Kootenay Power and Light Company, Limited, by its amended application, applied to the International Joint Commission for approval of the drawings, plans and specifications filed with its said amended application, and for the right to construct the works in accordance therewith, and when so constructed to operate them in the manner described in said amended application so that storage of water may be obtained in Kootenay lake and river by permitting the passage of the normal seasonal high flow in the spring and summer months and by partially closing the sluice gates of Corra Linn dam when the water in Kootenay lake at Nelson reaches a stage approximately 4 feet (that is, at elevation 1743·32 Geodetic Survey of Canada Datum 1928) above the average low-water mark, and then after the 31st of August each year by allowing the lake to rise slowly until it has reached a stage on the main lake 6 feet above the average low-water mark (that is, at elevation 1745·32) and maintaining the elevation of the water of the main lake not higher than this elevation and drawing said elevation down during the low-water months as required for the development of power in the power-generating plants of the applicant on Kootenay river; provided, however, the following conditions be fulfilled, namely: The main lake elevation not to be higher than 1744 on the 1st of February, 1742·4 on the 1st of March, and 1740·8 on the 1st of April if the said storage season has not terminated before this date due to the commencement of the annual flood rise.

Applicant's Works and Interests on River. The Corra Linn dam, a part of the works mentioned in the amended application, has been completed and is in operation as a power dam, this dam being wholly Canadian in purpose and effect. It may be pointed out in passing that it was necessary to construct the dam to its present height and to provide control features as at present constructed to ensure the proper operation of the power undertaking throughout all seasons of flow, quite irrespective of its possible future use as a storage dam. When and if this application for storage is allowed, and the dam is operated to effect said storage, the water of Kootenay river at the international boundary line will be raised during the storage period. The compensatory works in Kootenay river from Corra Linn dam to Granite, shown in the plans and specifications of the amended application, have likewise been completed. This work was done to compensate for the reduction in hydraulic gradient of the river which would result from the construction of Corra Linn dam. The real control point for Kootenay lake, however, is at Groham Narrows, and no work has been performed at this point.

The applicant, being legally entitled by proper governmental authority to develop power on the Kootenay river between Nelson and the Columbia river, has erected and put into operation four power plants with a total installed capacity of 224,000 horse-power providing 10,400 cubic feet per second of water in Kootenay river is available. Since, however, the amount of water flowing in the river varies in an average year from 107,000 c.f.s. during the flood period, to 4,800 c.f.s. in the low-water period (actually in 1930 low water there was only

4,100 c.f.s.), the said power plants are limited during the low-water period to approximately fifty per cent of their capacity, or 112,000 horse-power (96,400 horse-power being the limit in 1930).

It is possible to obtain a larger regular supply of water through the low-water periods by storing water in Kootenay lake by the works and in the manner set forth in the amended application and the evidence put upon the record.

Enlarging Grohman Narrows to Reduce Flood Levels. The additional work to be done by the applicant if and when this application is granted, and before the Corra Linn dam can be used as a storage dam, consists in the removal of 250,000 cubic yards of gravel, rock and boulders from Grohman narrows situated just below the city of Nelson, where what is commonly called the West arm of Kootenay lake outlets into Kootenay river, which work would enlarge the outlet channel and make it possible for a greater flow of water to leave Kootenay lake during both the flood period and the low-water period than can pass at the present time. As a result of this enlargement of Grohman narrows, the flood level of Kootenay lake and therefore Kootenay river at the international boundary line will be reduced; and because a greater amount of water will be able to pass during the low-water stages, the applicant will be able to ensure that the storage waters held by Corra Linn dam are out of the lake when the increased flow into the lake commences as a result of the spring thaw.

Discharge Capacity of Dam and Power House. The joint report of the Canadian and United States Governments, signed by Mr. J. T. Johnston for Canada and by Mr. N. C. Grover for the United States, bears out the evidence of the applicant in showing that the Corra Linn dam and power house were constructed to discharge a greater quantity of water than any flood period on record has provided, or some 72,000 c.f.s. more than the largest flood known, namely that of 1894 when the flow was about 200,000 c.f.s.

It is further agreed that if Grohman narrows is improved as proposed by the excavation of 250,000 cubic yards, the discharge capacity of the dam is sufficient, if properly regulated and controlled, to permit the drawing down of the water levels of Kootenay lake and in the river reaches extending upstream to Bonners Ferry, to an elevation well below the elevations which would obtain under natural conditions.

Effect of Enlarging Grohman Narrows and Other River Improvements. The applicant proposes to enlarge Grohman narrows by the removal from the river channel of 250,000 cubic yards of material in order to enable it to draw down the storage it seeks to elevation 1740·8 at the 1st of April if the said storage period has not sooner ended.

The applicant further agrees to excavate, if necessary, such additional yardage as will ensure that the said objective can be substantially accomplished.

The flood relief to be afforded by this work is stated in the aforesaid Joint Report, as follows:—

"These studies warrant the following conclusions:—

"(*a*) That the excavation of 250,000 cubic yards at Grohman narrows will have a substantially beneficial effect in lowering the water levels throughout the Kootenay flats reach.

"(*b*) The Canadian computations show that the amount of this lowering will vary from 1 to 4 feet depending upon the relationship of the flow through the flats to the elevation of Kootenay lake, or, under free discharge, to the flow through the Kootenay river below Nelson. The United States computations show that under the combinations of factors conceived as likely to occur at times of large floods, the lowering in Idaho would vary from 1 to 2 feet, such lowering being approximately 1·50 to 2·00 feet at Port Hill and 1·00 to 1·50 feet at Bonners Ferry.

"(*c*) That properly planned additional excavation at the control points in the lake outlet (i.e. over and above the 250,000 cubic yards) would be conducive to a further beneficial lowering of the water levels in the Kootenay flats reach by an amount proportional in some reduced measure to the amount of further excavation undertaken."

In passing, it might be noted that the applicant's only objection to the above findings is that the different factors, co-efficients, formulæ and premises used to compute the amount of lowering in water levels are all on the conservative side (as was admitted by Mr. Johnston) and the applicant is satisfied that the figures given by its engineers will be found in actual operation to be more nearly correct. Where Messrs. Grover and Johnston find respectively a lowering of the lake level during the flood period of 2·7 and 4·05 feet for a flood flow of 225,000 c.f.s., the applicant's evidence is that with a flow of 200,000 c.f.s. the lake will be lowered 4·6 feet at Kootenay Landing; 3·9 feet at Port Hill, Idaho; 3·5 feet at Copeland, Idaho, and 3 feet at Bonners Ferry, Idaho. With a flood flow such as that of 1916 when 143,210 c.f.s. was discharging from the lake, the lowering effected would be approximately as follows: Kootenay Landing 3·15 feet; Port Hill 2·8 feet; Copeland 2·4 feet, and Bonners Ferry 1·9 feet.

Beneficial Results to Idaho from Flood Relief. While the owners and farmers of the reclaimed districts who gave evidence attempted to minimize the benefits that would result from flood relief, none of the engineers who gave evidence or filed reports from the United States Geological Survey, nor for the Dominion of Canada nor the applicant, sustained them in this, and all of them who deal with the flood relief study admitted that substantial benefits would accrue to the reclaimed districts involved.

The question of benefit to the reclaimed districts in Idaho involves two phases: (1) The lowering of the flood peak to prevent the over-topping of the dikes; (2) The lowering of the river levels from the end of the storage period until the flood peak and on the receding stage after the flood peak, thus decreasing at all times the pressure of water against the dikes; decreasing the length of time during which any given flood pressure would be against the dikes; decreasing the amount of seepage and flow of water into, through and under the dikes; lowering the cost of pumping water that has accumulated in the district from the above mentioned sources or from the surrounding mountains and land; and greatly lessening the hazard of the dike becoming saturated by seepage and so giving way before it is over-topped.

It was explained at the hearing by several of the owners and farmers of the districts (Transcript pages 313 to 395 Nelson Hearing 1933) that the several districts which were flooded in 1933 were flooded not because the level of the water overtopped the dikes, but because the dikes disintegrated at places in consequence of becoming saturated long before the water reached the level that would overtop them.

When Mr. Davenport, Senior Hydraulic Engineer of the United States Geological Survey, in Exhibit 1, pages 15 and 16, states that only once in twenty years on the average would the lowering proposed by us and stated by him to amount to 1 to 2 feet, have materially reduced the loss and damage, he is referring to the loss and damage caused by over-topping of the dikes, and not to the serious loss and damage that might occur in any year from a much lower flood. He goes on to state at page 16, however, that in eighteeen out of twenty years there would be some reduction of seepage into the drainage districts and a decrease in pumping heads during the flood period.

In 1933 an area of 9,000 acres, or 28 per cent of the total reclaimed acreage in Idaho, was flooded by the high levels of Kootenay river in five districts. None of these districts were flooded in consequence of the river water over-

topping the dikes, but in consequence of the sustained pressure of the river against the dikes causing them to become saturated with seepage and disintegrate at weak points.

Mr. Davenport's Exhibit 1 is dated June, 1933, and no doubt was prepared before the flood peak of 1933. Had he considered the 1933 flood as being capable of flooding 28 per cent of the total reclaimed acreage in Idaho, he would have included the floods of 1921, 1927, 1928 and 1933 with those of 1894, 1916, 1903 and 1913 as capable of doing serious damage, and then he probably would have found that a reduction in the flood level of 1 to 2 feet, as conceded by him, would have resulted in the difference between serious loss and comparatively small loss in four out of the last seventeen years since the very high flood of 1916, being the years 1921 when the elevation of the water on the Nelson gauge at flood peak was at 1,757·62, 1927 at 1,757·12, 1928 at 1758·32 and 1933 at 1,758·42.

It must easily be seen, then, that in the years when the flood does not reach proportions to over-top the dikes, very substantial benefit would accrue from any reduction in the flood level, possibly in a very large proportion of the cases making the difference between heavy and insignificant damage.

Mr. J. T. Johnston, in Canadian Government Exhibit 1, page 28, has the following to say concerning the benefit to accrue to Idaho from the applicant's proposed works:—

> " The foregoing clearly demonstrates that the excavation already made by the company in the reach from Corra Linn to Granite has had substantial beneficial effects during high water by lowering the level of Kootenay lake and of Kootenay river above—to the benefit of the reclamation interests of Kootenay flats on both sides of the boundary.
>
> "It also demonstrates that the proposed further excavation of 250,000 cubic yards at Grohman narrows will provide for the further very substantial lowering of these waters during high water periods—to the further substantial benefit of these reclamation areas.
>
> " A lowering of from 1 to 2 to 3 to 4 feet of the water levels in the Kootenay river during high water season at a time when the reclamation dikes are strained possibly to the breaking point, will be the result of the additional excavation proposed by the Company at Grohman narrows."

Furthermore, several engineers and corps of engineers for the Government of the United States and the State of Idaho and the reclamation interests, the Government of British Columbia and for private parties, have investigated in the past the feasibility of reclaiming Kootenay valley lands in Idaho and British Columbia, and their conclusions place great importance on the necessity of lowering Kootenay lake during the high water season by means of excavation of the control point in the lake outlet.

Earlier Investigations. Brief reference is made to the following investigations made for the sole purpose of advising on the most feasible methods of reclaiming Kootenay valley low lands in British Columbia and Idaho:—

A. S. Farwell in 1883 advised that the reclamation of Kootenay flats involved excavations in the outlet controlling the lake.

Wm. A. Baillie-Grohman in 1886, having a private reclamation scheme on the British Columbia side, actually commenced the work of enlarging Grohman narrows, this being the first attempt to reclaim Kootenay flats.

Mr. Otto Weile, Consulting Engineer of Spokane, Wash., later reported that it was necessary to enlarge the outlet of the lake and provide control works in the outlet.

In 1912 Mr. H. F. Meurling for the Province of British Columbia reported that to reclaim Kootenay flats it was necessary to control the level of Kootenay

lake by the construction of control works at Grohman creek and by deepening and enlarging the channel above and below such point of control. His control works called for a dam below Grohman narrows.

L. A. Jones and C. E. Ramser, Drainage Engineers of the Department of Agriculture of the United States, in 1915 and 1916 investigated the reclamation project and, among other schemes, reported two that involved the enlargement of the outlet of Kootenay lake as an essential part of any complete scheme of reclamation. Enlarging the outlet of Kootenay lake would entail the construction of a control dam to protect navigation in the lake, and they were of the opinion that the cost of enlargement and control works was prohibitive in the reclamation scheme.

W. G. Sloan for the Reclamation Commission of the State of Idaho, in 1921 reported that in order to reclaim the Kootenay valley lands in Idaho it would be necessary to enlarge the outlet from Kootenay lake and erect a regulating control dam at Granite.

In 1922 a joint report by the State of Idaho and Province of British Columbia, by W. G. Swendsen, Commissioner of Reclamation, Idaho, and E. A. Cleveland, Comptroller of Water Rights, British Columbia, had as a cardinal feature the enlargement of the outlet of Kootenay lake and the construction of a control dam at Granite.

Finally, after the original application of the applicant was made to this Honourable Commission, an investigation was made pursuant to Act of Congress of February 12, 1929, by the U.S. Corps of Army Engineers, and a report in due time of Major John S. Butler of the United States Corps of Engineers and district Engineer at Seattle, was submitted to the 72nd Congress, First Session, as Document No. 157. Mr. Johnston summarizes this report at Transcript pages 156-157 (Nelson Hearing, 1933) as follows:—

> " Briefly, the report of the United States Corps of Engineers to the Secretary of War points out:—
>
> " That the safeguarding of the drainage districts in Idaho from flooding out in high water is dependent upon the enlargement of the outlet of Kootenay lake, or, alternatively, the diversion of the Upper Kootenay into the Columbia river through what is known as Canal Flats, or a combination of the two—both of which operations must be undertaken in Canada;
>
> " That material raising of the dikes or deepening of the channel in Idaho is infeasible;
>
> " That the reclamation areas in Idaho are at present probably subject to the possibilities of greater damage from floods during the summer season than from improper drainage of the subsoil due to the raising of the water table during the fall and winter months;
>
> " That the use of the storage as proposed by the West Kootenay Power and Light Company is desirable for the highest utilization of the potential power in the Kootenay and Columbia rivers, that is to say in the power reach of the Columbia river lying within the United States.
>
> " That the protection of the drainage districts by the enlargement of the lake outlet can be effected only by joint action between Canada and the United States which action can best be secured by the International Joint Commission;
>
> " In brief, the report of the War Department may be termed to be a complete endorsation of the proposals of the West Kootenay Power and Light Co. as beneficial to the drainage interests in Idaho."

Any of the aforesaid reclamation schemes involving enlarging the lake outlet and building control works at or below the outlet added too great a cost when it had to be borne by the land being reclaimed. Such work however would be done by the applicant at no cost to the land and the basis laid for the successful reclamation of the lands.

Raised River Levels During Storage. The various parties engaged to estimate the extent to which the proposed storage would raise the river levels during the months from September to March, inclusive, each year, reached different results. The difference between these parties depends substantially upon the premises used and upon the number of past years over which the average was struck. All parties took a certain number of years in the past, up to and including the year preceding the date of their respective reports, and, knowing from gauge readings the actual elevation of Kootenay river in Idaho during said years, they computed the degree to which the storage would raise the level had it been in effect for each of said years; thereby a mean elevation and an average elevation by months was obtained.

In the aforesaid joint report, Canadian-United States Governments Exhibit 1, the difference between the Canadian and American computations is set out and we find that, by striking an average between them, 0·32 feet would be added to the Canadian figures and the same deducted from the United States figures, and substantially then this average level would agree with the level found by Mr. Tindale, one of the applicant's engineers. Mr. Tindale computed the levels during the storage period would be increased as follows:—

September, 1·23 feet; October, 2·71 feet; November, 3·48 feet; December. 4·23 feet; January, 4·24 feet; February, 3·03 feet; March, 1·41 feet.

By the first of April storage would be exhausted and the level of the river returned to what it would have been under natural conditions. From this time on to the commencement of the next storage period, the levels would always be lower than under natural conditions.

Thus it is seen that only during the fall and winter months will the level of the river be increased in consequence of our storage, and that in the months of April, May, and June and the balance of the crop year, the levels would be lower than under natural conditions.

Effect of Increased Levels During Storage Period. It is admitted by all parties that the land of the reclaimed districts in Idaho adjacent to the river is much higher than the land in the district further from the river, the slope of the land surface being highest at the river and lowest back at the foothills. The dike is built on top of the natural bank. Inside the natural bank of the river is the high or "levee" area which constitutes a substantial strip of land some 8·75 feet higher than the highest storage level. Going up the river towards Bonners Ferry, the elevation of the high levee area increases progressively, enlarging the margin of difference between the surface of the land in the said area and the storage level. From the high or levee area the land slopes to what Mr. Newell of the United States Geological Survey calls the "other area" which is still substantially higher than said storage lines, and even the lowest land beyond the "other area," constituting Mr. Newell's "critical area" is higher than said storage lines.

This strip of land with such an ample margin between the level of the high storage line and the level of the surface of the ground, will be an absolute impediment to the seepage of water from the river to the lower lands beyond this strip.

This is apparently a fact admitted by all parties, for Mr. T. R. Newell, who gave to this Honourable Commission the interpretation of the United States Geological Survey from the ground water study, nowhere suggests that there will be increased seepage from the river to the so-called "critical area." His claim is that the increased level of the river under storage will decrease the head opportunity between the water table in the critical area and the river, and therefore decrease the amount of seepage from the critical area to the river. His basis for such a claim is found only in his Inventory Method of Analysis, which is based mostly on assumptions and which will be dealt with later.

Encroachment of Storage Levels Upon Sluice Gates. Although the water from the increased elevation of the river could not get through this elevated land, it could enter certain of the districts through the sluice gates unless the gates were kept closed, in consequence of the encroachment upon certain of the sluice gates by the higher levels. The maximum mean storage elevation line for September shown upon Plan F-291 encroaches upon the sluice gates of District 8, the bottom of which is at elevation 1744·82; of District 6, at 1742·80; of District 11, at 1743·40; of District 7, at 1745·40; of District 1, at 1743·30.

Since the river water will not pass through the banks and levee areas of any of the districts, and since no encroachment even by the maximum storage line will occur with respect to any of the districts except 8, 6, 11, 7 and 1, only those districts need be considered.

If we assume, then, that the sluice gates are left open during the storage period and the water is allowed to back up into the drain ditches of the aforesaid five districts, the question of whether or not there will be any injury done to the land reclaimed will depend upon the distance between the surface of the lowest land in the district and the elevation of the water in the drain ditch only for the distance from that drain ditch through which the water will seep, and thus raise the water table level. If there is a sufficient margin between the surface of the lowest land in the district and the elevation at which the storage line will be (for the water in the drain cannot be higher than this line) then no injury will be done at any time during the storage period. If there were not a sufficient margin, then the gate would have to be kept closed and any additional water accumulating from the drainage of the district would have to be pumped out, until the elevation of the storage line receded to the point where it would run out by gravity.

Taking each of these storage districts in turn, the applicant showed the margin existing between the lowest land and the highest mean storage line of September; also the greatly increased margin existing by the month of February, the latter month being the commencement of what is described in the Newell-Jessup studies as the "critical period." This margin for the districts involved is as follows:—

District 8: 18 acres only will have a margin of 5 feet; 593 acres, 5 to 6 feet; the balance, 2,310 acres, over 6 feet in the month of September. By the month of February this margin for all the land has been increased by 3 feet, so that the lowest land would be about 8 feet higher than the February mean storage line.

District 6: The lowest land, about 160 acres, has a margin of 2 to 3 feet; the area having a margin of 3 to 4 feet would be 315 acres; 1,732 acres would have a margin of 6 feet or less, and the balance, 3,869 acres, would be greater, during the month of September. By the month of February this margin for all lands is increased by 2·7 feet, making the lowest land 4·7 feet above the storage line.

District 11: The lowest land in this district will be 7·3 feet above the September storage line, and over 10 feet above the February mean storage line.

District 7: The lowest land, 5 acres only, has a margin of 3 feet, 294 acres a margin of 5 feet or less, 793 acres a margin of 7 feet or less, and the balance, 1,372 acres, greater. This would be increased by the month of February by 2·4 feet, making the lowest land 5·4 feet above the storage level.

District 1: The lowest land, comprising 370 acres, would be about 2 feet above the September storage line; 447 acres, 2 to 3 feet above; 859 acres, 3 to 5 feet above; and the balance, 2,748 acres, greater. This is increased by the month of February by 3·4 feet, making the lowest land then over 5 feet above the February storage line.

Mr. Jessup of the United States Department of Agriculture, Bureau of Agricultural Engineering, in Jessup Exhibit 2, page 5, indicates that a depth between land surface and water table of from 2 to 5 feet is the best for the crops now being grown. A suggestion was made at the Hearing that for certain other crops, such as alfalfa, a greater depth to water table would be required. With only small acreages showing the smaller margins between storage lines and the surface of the ground, and the very large acreages showing a very ample margin and sometimes apparently too great a margin, no difficulty ensues to prevent the farmers of the districts growing any crop they wish. The applicant submits, then, that with the higher storage lines, even though the gates are left open, no injury could possibly be done to the lands by encroachment of the river, and no additional pumping would be required.

Objections to the Application. Objection is made that, in consequence of the higher levels of Kootenay river that will prevail from Bonners Ferry to the international boundary, during the storage period, the water table within the drainage districts in Idaho will be higher at planting time and that as a result of this, damage will ensue to these districts. No objection is made in consequence of the river conditions that will prevail from the end of the storage period throughout the flood period and to the commencement of the next storage period, it being admitted that throughout this phase of the river cycle benefit will accrue to said interests.

A study of the water table of the districts was made by the United States Geological Survey, financially assisted by the applicant, and all parties used the base data obtained therefrom in drawing the conclusions and offering the opinions that were presented to the Commission.

The net result of studies by engineers of three independent organizations is that two of them, the Canadian Government and the applicant, find that no damage will ensue as a result of any prospective rise in water table in the district, while the third, by Messrs. Newell and Jessup for the United States Government, finds that there are certain areas of low land within the various districts that will suffer injury if the storage is allowed. This low area is called the "critical area".

The applicant calls attention to three phases of the Newell-Jessup studies to show that they are totally inadequate and lead to wholly erroneous conclusions. Two of these phases have to do with the areas which were investigated and are now considered under the heading "The Critical Areas". The third phase, equally important, has to do with the total inadequacy of the inventory method of analysis discussed later under that heading.

Critical Areas. *The First Phase:* With regard to the areas investigated and reported upon by Messrs. Newell and Jessup, the applicant contends (without prejudice to the argument hereinafter that their studies are basically in error) that the Newell and Jessup exhibits contain ample evidence to show that these studies were confined to those areas in which it was considered serious damage might be expected and did not include those higher lands in which the Jessup evidence would indicate a benefit is to be expected.

On page 5, Newell Exhibit 11, Mr. Newell states, "High lands along the river levees, where water table is far below the ground surface, may not be so adversely affected from an agricultural standpoint by a higher water table in the spring. There are, however, bordering lands between the 'levee areas' and the 'critical areas' which, following a season of greater precipitation, would suffer similarly to the featured low lands. Following a season of smaller precipitation the water table characteristics of these bordering or in-between lands would place them in the classification with the higher levee lands which might not be so adversely affected by increased elevation of water table."

It is evident from this that Mr. Newell is considering only the damaging effects of a rise in water table in certain areas and not the net effects to the districts and that he considers that he has included in the critical areas all lands which would be adversely affected to a serious degree in a year of ordinary supply.

Assuming for the moment that the Newell and Jessup studies of the critical areas are representative, the applicant contends that they indicate that the land bordering the critical areas contains many acres which would be benefited by a moderate rise in water table and that had the bordering lands been included in the investigation, as they should have been in order to present the complete story to the Commission, the net damage in each district would be greatly decreased.

The Second Phase: With regard to the areas investigated and reported upon by Messrs. Newell and Jessup, the base data in the Newell Exhibits show that these areas, which Mr. Newell has termed "critical areas," were determined at a time when water was being held within the sumps and drains of the districts, and furthermore that much of the data in connection with the ground water study is affected in varying and unknown degrees by this same artificial condition resulting from the action of the district owners or other parties in closing the gate in the gravity outlet, or preventing the function of these drains by dams or other obstructions, during the natural drainage period.

This act of holding water in the drainage ditches and within the so-called critical areas must of necessity raise the water table within these adjacent areas. As a result of this the Commission is presented with an artificially created picture of critical areas which in effect says: "Here you see our Drainage Districts which we have constructed at great cost by building dikes to keep the high water out and drains to carry off the surface water and keep the water table down. Here are large areas of low land in which we find that if the water table is too near the surface our crops are detrimentally affected and the yield is decreased. Even with the present drainage facilities we have difficulty in draining these low lands and suffer from a high water table. It is evident therefore that anything which would tend to raise that water table would affect these areas very seriously."

That is the picture that is painted in face of the actual fact that the drains in those districts during the investigation were not being used to drain the low lands during the natural drainage periods, but, on the contrary, were actually being used in many cases to hold water in the districts and within the so-called "critical areas" with, it is obvious, the purpose of raising the water table in the hope of increasing the yield.

The Inventory Method of Analysis. In this method Mr. Newell attempts to account for all water entering the districts and all leaving the districts by any means other than seepage, and having measured the quantity in the soil at the commencement of the period under investigation and the quantity in the soil at the end of the period he concludes the surplus has seeped to the river. From this Mr. Newell computes the effect that the increase in level of the river under storage would have in decreasing seepage and therefore raising the water table.

A study of this method indicates that in order to obtain representative results not only must all contributing and dissipating factors be taken into account but an accurate value must be applied to each item. The applicant contends that in the analyses under discussion this accuracy is missing and that the very nature of the problem and the conditions obtaining in the Kootenay valley make its attainment wholly impracticable.

The values applied to the seven factors employed in Mr. Newell's inventory analysis (viz., precipitation, district concentration, run-off from adjacent side hill area, evapo-transpiration, drainage and pumpage, moisture on hand and finally seepage from adjacent hills and mountains) are all to a greater or lesser degree based on assumption, guesswork and incomplete data. The applicant contends that values applied to seven such unknowns by means of assumptions in order to segregate an eighth unknown, viz., amount of, and subsequently, rate of seepage between the water table of the critical areas and the river or vice versa can only result in an entirely erroneous answer. Moreover, the lack of data by means of which to approximate even closely the very important item of seepage from the hills makes the inventory method of analysis entirely irrelevant in the Kootenay valley however valuable it may be for similar work under different conditions.

But the assumptions are not ended with the determination of the rate of seepage. It may be pointed out that the quantities of water which Mr. Newell claims would enter the ditches of Districts 7 and 4 in the B and D periods after storage is in effect, as given at the foot of pages 27 and 12, Newell Exhibits 9 and 10, respectively, can only to a large extent be based upon assumptions for the reason that the quantities apply to a theoretically deduced future condition and are not in any event susceptible to actual measurement. The task of making accurate assumptions is further complicated by the fact that during the investigation period water was held in the sumps and drains.

It is evident that assumptions of this type are subject to considerable error and contribute to erroneous conclusions.

It is therefore the applicant's contention, as amply supported by the foregoing, that the inventory method of analysis is not applicable to the Kootenay valley and that the results obtained in the Newell Exhibits, being dependent upon this method, are in the last analysis merely assumptions which the results of studies of engineers of the Dominion Government and of the applicant show to be in serious error.

It is also pointed out that wholly apart from the inapplicability of the Inventory Method of Analysis to the conditions obtaining in Kootenay valley as demonstrated in the foregoing, the fact that the water was artificially held in the drain ditches within and adjacent to the critical area, has completely established,

(*a*) that the natural river levels during the winter season do not maintain the most advantageous conditions in the drainage district for the best crop production;

(*b*) that, on the contrary, better conditions for crop production are obtained in raising the ground water levels in the drainage district by artificially holding the water in the ditches and sumps at higher elevations than those proposed by the applicant in the immediately adjacent river channel;

and, in effect, has completely destroyed the theoretical conclusions reached in the Newell and Jessup exhibits that any detrimental effect on crop production in the districts could be caused by the applicant's storage proposal.

Conditions Prevailing in the Drainage Districts during the Newell "Critical Area" Study. Mr. Newell treats all the districts as if composed of "levee," "other" and "critical" areas, but as he does not consider that the higher storage level of Kootenay river will affect the "levee" or "other" areas, he confines his evidence concerning these districts to the "critical" areas.

As a premise to the water table study, Mr. Newell assumes that the encroachments of the higher river on the drainage outlets were cared for and

that interior drain levels were not enhanced by the retarded flow through these outlets. Yet the records submitted by Mr. Newell indicate that the level of the water in the interior drains in and adjacent to the so-called critical areas, was enhanced by the retarded flow through the outlets and in certain cases the higher river did encroach upon the outlets, and the outlets were opened to allow the water from the river to back into the drain ditches to keep the water in said drain ditches higher than it could have been under storage conditions.

According to Mr. Newell there is a critical period for the critical area, and if injury is to follow it is in consequence of the conditions that would prevail during this critical period in the critical area, the critical period being the late winter and spring of each year, or between February 15 and May 1.

Districts 4 and 7 were dealt with particularly by all investigators. Using, for the most part, the evidence and data supplied by Mr. Newell, the objections to the application are easily refuted.

In both districts free drainage was obstructed, at all times during the period of investigation, by farmers who used the drains in the critical area as irrigation ditches in an attempt to keep up the water table in order to assist crop production. As a result, the elevation of the water in the "critical" area drains was higher than would have been the case under free drainage conditions, and even higher, actually, than would have been the case had the storage proposed in the application been in effect.

Wells located in the "critical" area were studied in order to ascertain what relationship, if any, existed between the water table in the "critical" areas and the level of the river or drains.

Using Mr. Newell's own data whereby he shows the water in the said drains to be higher than the water in the wells, it is clear that the proposed storage level can have no effect whatever upon the water table in these districts: if water did not seep from the drains to raise the water table in the "critical" area wells during the period of investigation, it is inconceivable that a storage line even lower than the level of the water in the said drains will have any effect. A study of the Average of Critical Wells Curve shows positively that no relationship exists between it and the level of the river during the low water period and little, if any, relationship during the high water period.

Mr. Fred. Mathews, on behalf of the applicant, found that the wells near the river were influenced slightly by the river level, but that the wells along the foothills (in which area is located a substantial part of the "critical" area) were not influenced by the river level at all.

Messrs. Meek and Dawson of the Dominion Water Power and Hydrometric Bureau, in dealing with this point in their report, indicated that the water table was influenced by the river only a limited distance from it, and that assuming as an extreme case (and it is an assumption merely) that the maximum increase of the storage level will result in an equal increase of the water table in the adjacent land, 400 feet would be the possible width of the land affected by the proposed storage in District 7, and 1,000 feet in District 4.

To summarize the above, it is evident:—

1. That the "critical" area is substantially located along the foothills and at a considerable distance from the river;
2. That consequently any influence on the water table exerted by the river will extend but a short distance from the river and will have no effect upon the critical areas;
3. That the level of the water in the drains under storage can have absolutely no detrimental effect, as it will be kept lower than the present level of water in the said drains.

Those districts whose sluice gates will be somewhat encroached upon by the higher storage level, being districts 8, 6, 11 and 1, were next considered.

By a study of all available data it is evident that during the "critical period" the water in the "critical" area drains was much higher than the proposed storage level; and further, in all districts the operators wished to increase the water table during the "critical period" for the "critical" area and maintained the water in the ditches higher than it would have been under free drainage conditions at ploughing and planting time. In effect, this is a complete answer to the objection that storage will have a detrimental effect upon crop production.

Districts 3, 5, 12, 10 and 13, whose sluice gates will not be submerged in any way by the higher elevations caused by the proposed storage, were dealt with individually and the same conditions as those found to prevail in Districts 8, 6, 11 and 1 were found to exist, only to a more exaggerated degree. The water in the drain ditches and at reference points immediately adjacent to or within the "critical" area itself, was found to be, in all cases, several feet higher than the proposed storage level.

Thus the objections to the application with regard to these districts, as in the case of the other districts, are not sustained.

Evidence of L. T. Jessup, United States Department of Agriculture. Mr. Jessup took it for granted that Mr. Newell's evidence had proven that there would be an increase in the height of the water table in the "critical" areas. Since Mr. Newell has not proven the existence of "critical" areas that will be injured by the proposed storage levels, then Mr. Jessup's evidence as to the damage or injury that would occur becomes irrelevant.

It is, however, interesting to note that Mr. Jessup, Transcript page 294, where he explains the meaning of the curve on Jessup Exhibit 2, page 6, states that this curve shows that for the year 1930, the best depth of water table for organic soil was 2½ feet, and for mineral soil 3 to 3½ feet. This scientific finding explains the reason for the farmers of the district trying to hold the water table in the land at a higher elevation, in consequence of their experience that the best crops grew where the water table was at a very moderate distance from the surface.

This evidence also shows there is an ample margin between the present water table of the land in all the districts and the elevation of the highest proposed storage line, and that even if storage were in effect the practice of trying to raise the water table to get better crops would continue, except in years of very generous natural precipitation.

A further point dealt with in Mr. Jessup's summary, Exhibit 2, page 80, concerns the extra pumping that might ensue from the higher storage levels when they encroach upon the drainage outlets of any of the districts.

It will be noted, however, that the estimated pumping for District 1 and the probabilities concerning the other three districts are based on the premise used by Mr. Newell which, I have already demonstrated, was not in effect during Mr. Newell's investigation and therefore could not apply to Mr. Jessup's. Since the districts have kept more water inside their dikes in the past than would be retained there by the higher storage elevations, there would be no additional pumping to be done.

In view of the fact that Mr. G. E. Clark, District Counsel for the United States Indian Service, depended entirely upon the reports and evidence of Messrs. Newell and Jessup, which have been proven to be palpably erroneous, and in view of the fact that Mr. Guy C. McGee of Idaho founded his conclusions upon misconceptions as to the meaning and effect of the application, the representations and statements of these men cannot be considered to carry any weight.

Mr. A. Klockmann's Statement. Mr. Klockmann, Vice-President of the Reclamation Company in Idaho, and owner of District 5 containing 2,000 acres of which about 1,000 are under dike, and owner of 2,000 acres of unreclaimed land opposite District 8, which he intended to reclaim in 1933, appeared before

the Commission asking that approval be given to the application because he feared the destruction that his and the other districts faced every spring from the high levels of the river during the flood period, stating that the lowering of the flood level by even 1 foot would be of great importance to him in saving his district from flooding and that he believed that the amount of reduction already effected by the applicant, without any enlargement of Grohman narrows, had been the means of saving his district and possibly other districts in 1933.

He further stated that with an increase of 6 feet in the elevation of Kootenay river during the storage period (and it will be noted that it actually will not be 6 feet at Mr. Klockmann's district) no possible damage could come to his district from additional seepage, as it has been his practice to allow the river to rise from low water a distance of 12 feet before even closing his sluice gates. He further stated that nine of the other districts were in the same position as his; that no injury could possibly come to these districts, and that he was convinced that the benefit of reducing the flood would offset any possible damage in the others.

His experience had taught him that the water table in the districts should be very close to the surface, and that he had obtained his best crops from land where the water table was within 1 foot of the surface.

Beneficial Effect of Storage to the State of Washington. W. E. Southard, Trustee of the Columbia River Development League of Wenatchee, Washington, and Rufus Woods, member of the Columbia Basin Commission of the State of Washington, called the attention of the Commission to the great value of storage in Kootenay lake to power interests in the state of Washington, since all storage water of Kootenay lake would be passed on to the Columbia river, and this without cost to said interests. This would mean an addition of 50,000 to 60,000 horse-power for the first unit alone, and approximately 140,000 horse-power added to the production of the Grand Coulee power project if the high dam now talked about was built.

Dr. T. H. Hogg had also investigated the power possibilities of the Columbia river below the international boundary line, and stated that " benefits of immense value will accrue to power sites on the Columbia river below the international boundary ". He also explained that in addition to the 140,000 horse-power additional production at Grand Coulee that was possible, there were six other power sites upon the river which, if all used, would mean an addition of 300,000 horse-power that would accrue to the power interests in the state of Washington, without any additional cost to them.

Conclusion. The flood relief afforded to the reclamation districts in Idaho has been proven and admitted to be substantial. Engineers for the interested governments and otherwise in the past have advocated the carrying out of improvements at Grohman narrows and the erection of control works below Grohman narrows as a fundamental feature of any successful reclamation of the low lands of Kootenay valley in Idaho and British Columbia, the expense of which would be a charge against the lands reclaimed. Such improvements and control works will be provided in the present scheme of the applicant without cost to the reclamation interests. In these works the foundation is laid for further improvements both at Grohman and Proctor narrows, and other control points, affording additional relief from flood hazard.

The evidence of the applicant and of the Dominion of Canada has shown that no injury will be done to the reclamation districts or any other interests by the increased levels of Kootenay river in Idaho during the storage period. The evidence produced by any party objecting to the application has failed to prove that any injury will be done, the data on the record showing that there

will be no injury from the storage levels and that the conditions existing during the period of study have been worse than the conditions that will prevail when storage is in effect.

Substantial benefit will ensue to power interests in the state of Washington, from the storage of water in Kootenay lake as applied for.

Two paragraphs from Canadian Government Exhibit 8, being a report from the Chief of Engineers, United States Army, Document No. 157 of the 72nd Congress, First Session, House of Representatives of the United States, now quoted from page 29, constitute an appropriate summary:—

> "In connection with the dam and compensatory works proposed by the West Kootenay Power and Light Co., it seems that the use of storage as proposed is desirable for the highest utilization of the potential power in the Kootenay and in the Columbia, and the compensatory works will be of benefit during the flood stages to all overflow lands in the valley above the lake, in Canada as well as in the United States, in that it will increase the discharge capacity of the river.
>
> "The reclaimed areas in Idaho are at present probably subject to the possibilities of greater damage from floods during the summer season than from improper drainage of the subsoil due to raising the water table during the fall and winter months."

No damage will be done and no additional expense will be incurred by Idaho interests. Substantial benefit will accrue to all United States interests, therefore the applicant most respectfully requests that this Honourable Commission grant its application.

Summary of Brief Submitted on Behalf of His Majesty's Government in Canada

The "Brief filed on behalf of the Government of Canada" January 5, 1934, by J. E. Read, K.C., Legal Adviser, Department of External Affairs, may be summarized as follows:—

Nature of the Application. Under the heading "Nature of the Application" the Brief points out that the application, coming under Article IV of the Boundary Waters Treaty, 1909, which provides as follows:—

> "The High Contracting Parties agree that, except in cases provided for by special agreement between them, they will not permit the construction or maintenance on their respective sides of the boundary of any remedial or protective works or any dams or other obstructions in waters flowing from boundary waters or in waters at a lower level than the boundary in rivers flowing across the boundary, the effect of which is to raise the natural level of waters on the other side of the boundary unless the construction or maintenance thereof is approved by the aforesaid International Joint Commission."
>
> "It is further agreed that the waters herein defined as boundary waters and waters flowing across the boundary shall not be polluted on either side to the injury of health or property on the other."

was made by the West Kootenay Power and Light Company, Limited, to the Government of Canada and was transmitted to the International Joint Commission for appropriate action.

The Brief then takes issue with the contention of the Attorney-General of the State of Idaho as expressed at the hearing at Nelson that the Commission did not have jurisdiction to deal with the application on the three following grounds:—

"(1) That the Commission did not have the power to authorize a permanent, as distinct from a temporary, obstruction, the effect of which would be to raise the natural level of waters on the other side of the boundary.

"(2) That the Commission did not have jurisdiction to deal with an application by a private enterprise.

"(3) That the Commission did not have jurisdiction to authorize an obstruction that would interfere with the drainage of lands in the United States, into streams flowing into boundary waters and that, therefore, the project could not be authorized in that it interfered with such drainage."

With regard to the first of these it is pointed out: that there is nothing in the Treaty to indicate an intention to restrict its operation to temporary obstructions or diversions; that such a restricted interpretation would be entirely inconsistent with the provisions of Article VIII which contemplate remedial or protective works and the protection and indemnity of interests affected, measures appropriate only to permanent obstructions, and that such an interpretation would be inconsistent with the position taken by the Commission during more than twenty years.

With regard to the second objection it is pointed out: that such a contention would defeat the whole object of the Treaty; that in most of the States bordering on the international boundary line and in most of the provinces of Canada, the economic development of boundary waters and waters flowing across the boundary is in the hands of private interests and corporations; that an interpretation of the Treaty which excluded from its operation the development of power and irrigation resources would frustrate the development of very substantial areas in both countries; that there is nothing in the Treaty to indicate that development by private interests is excluded from its provisions and that the fact that both Governments have for more than twenty-one years acquiesced in and acted upon rules of procedure authorizing applications by private interests, would seem to be conclusive.

With regard to the third objection it is pointed out that the Kootenay river is neither a boundary water nor a stream flowing into a boundary water and that therefore the provision of the Protocol to the Treaty upon which the objection is based has no application in the present case.

In reply to the contention of the State of Idaho that the building of the dam at Corra Linn in itself constituted a breach of the Treaty it is pointed out that there is a head of some fifty feet available at the Corra Linn site which can be developed for power purposes without interference with the natural water levels at the international boundary and that such a development as distinct from the use of the dam for storage purposes is a matter falling wholly within the jurisdiction of Canada.

The Position of the Canadian Government. Under the heading "The Position of the Canadian Government" the Brief points out that in addition to the investigation of certain important aspects of the company's proposals with a view to assisting the Commission in dealing with the application, the Canadian Government is directly interested in the effect of the proposals upon navigation on Kootenay lake and river in British Columbia and upon the Indian reserves in Kootenay flats in British Columbia.

It is pointed out that with regard to navigation the project was approved by the Canadian Government acting under the Navigable Waters Protection Act because it was found that the project would improve navigation conditions, while with regard to its position as proprietor of riparian lands it was found, after

investigation, that these lands while they would be affected by the proposed levels would not be injuriously affected, the lessening of the flood flows in summer being a substantial benefit as against an unimportant increase in the low levels.

It is also stated that the other riparian interests in Canada have raised no objection to the project.

Character of the Issues. Under the heading "Character of the Issues" the Brief states that in drawing up the Boundary Waters Treaty and in establishing the International Joint Commission "the two countries clearly indicated their intention that the Commission was to be a tribunal with broad powers, having as its primary purpose and object the enabling of the development, on both sides of the international boundary, of the natural resources thereof. Its task was the reconciliation and adjustment of conflicting interests and its powers were ample for that purpose. The history of the International Joint Commission since its inception has demonstrated this principle."

The Brief points out that the Kootenay river is an international stream in the strictest sense of the word and states that in considering the application the river system as a whole should be kept in mind. It submits that there are two distinct issues before the Commission.

"*In the first place,* the Commission should weigh the advantages and disadvantages that may result from the project, with a view to determining whether or not it should be approved. In considering the advantages, the beneficial effect of the development of the power resources, both in Canada and the United States, which has not been questioned, merits consideration. Further, the admittedly beneficial influence of the project in lessening the dangers from flood waters in the Kootenay flats in both countries is important. These certain benefits should be weighed in the balance and compared with the possibility of adverse effect caused by raising of the low water levels in the Kootenay flats, both in Canada and in the United States. It is submitted that the Commission should not consider rejection of the project because of adverse effect upon privately or publicly owned lands in the Kootenay flats. The Treaty with its provisions for protective works, and possible indemnity, obviously contemplated that obstructions would be authorized that would cause damage. The Treaty clearly contemplated that the Commission would consider the balance of advantage and disadvantage and, that where the benefits that could be derived from a development outweighed the possible disadvantages, and especially where those possible disadvantages could be dealt with by protective works or indemnity, the Commission would authorize the project with adequate safeguards.

"*In the second place,* an issue was raised which comes into operation in the event that the Commission considers that the benefits to be derived from the project outweigh the possible disadvantages and consequently approves the project. This secondary issue is the determination as to whether, in the circumstances, there is any occasion for requiring protective works or indemnity. This depends upon a balancing of the advantages to the affected interests, with the possible disadvantages, in order to ascertain whether the affected interests would be in a worse position under the project than they were with the river at natural levels.

"In this respect the present application is radically different from most projects. The ordinary case of a dam in a stream backing water across the boundary, involves possible benefits to the owner of the dam, and nothing but detriment to the upper riparian interests. In the present project, provision has been made for conferring very substantial benefits to the riparian interests that are possibly affected during the storage season. The applicant in designing the

project has obviously planned to minimize even the possibility of adverse effect, and to make the project as a whole positively beneficial to the reclaimed areas above Kootenay Landing. Accordingly, the second issue is the determination of the question whether the project is, on the whole, beneficial to or detrimental to the reclamation projects in the Kootenay flats."

Summary of Points Established Before Commission. In summarizing the more important points which have been specifically established by the reports, base data, written briefs and oral arguments presented to the Commission, the brief calls attention to the fact that it has been established:—

(1) "that 'alkali is not present in the soils of Kootenay valley to a depth of 7 feet in sufficient quantities to be harmful to the growth of crops' and 'the raising of the water level in the winter will not have any effect on the alkali content of the soil.'

(2) "That the Corra Linn dam has been constructed with a discharging capacity much greater than the maximum known flood on the river; that if Grohman narrows is improved as proposed by the excavation of 250,000 cubic yards, the discharging capacity of the dam is sufficient, if properly regulated and controlled, to permit the drawing down of the water levels on Kootenay lake and in the river reach extending upstream to Bonners Ferry, to an elevation well below the elevations which would obtain under natural conditions.

(3) "That the effect of the company's storage proposals during the storage and draw-off period will be to retard the lowering of the waters in Kootenay lake and upstream therefrom to Bonners Ferry with the result that there will be recorded higher water elevations throughout this period and throughout this reach than would have been the case under natural run-off conditions (with the exception that at the date of the beginning of the spring inflow, the water levels will be again at their natural elevations);

"That the average increased depths which will result from the storage proposals of the company during the low water season, over and above the elevations which would have been recorded under actual run-off conditions, are very moderate in any one season—varying from 2·42 feet to 3·84 feet at Copeland and from 2·17 feet to 3·56 feet at Bonners Ferry.

(4) "That the channel excavation which has already been completed by the company between the dam and Grohman narrows will be of substantial benefit in lowering the levels of Kootenay lake during flood conditions, if control of the flow through the dam is exercised with that end in view;

"That in connection with flood flows experienced in the season of 1933, *the excavation already completed* by the company in the river channel, at and below Granite, had a material effect in lowering peak levels of the reach from Kootenay lake to Bonners Ferry below the point that would otherwise have been reached had such excavation not been completed;

"That the additional excavation of 250,000 cubic yards which is proposed at Grohman narrows will be of very substantial additional benefit *to the Drainage Districts* during flood conditions if control of the flow through the dam is exercised with that end in view;

"That in connection with the flood flows experienced in the season of 1933 *the excavation proposed at Grohman narrows*, would have had a very substantial effect in further lowering the peak levels below the actual recorded levels;

"That the excavation as proposed would provide for a more rapid run-off of flood water with a consequent retarded raising and more rapid lowering of the high water levels and with *a resultant easing of the pressure upon the dikes throughout the entire rising and falling stage of the high water period*;

"That the lowering effect of the excavation proposals upon water levels under high water conditions *is of direct beneficial value to the drainage districts;*

"That in connection with the flood flows experienced in the season of 1933 *the excavation already completed* by the company in the river channel at and below Granite *in conjunction with the excavation proposed at Grohman narrows,* would have had a very substantial effect in lowering the peak levels below the point that would otherwise have been reached without such excavation;

"That a program of additional excavation over and above the excavation of the 250,000 cubic yards, as now proposed, would be additionally beneficial to the drainage districts.

(5) "That *many extensive investigations and exhaustive studies* have been made into the possibilities of reclaiming the Kootenay flats lands, by United States and by Canadian engineers—representing United States and Canadian interests, public and private, including the United States Federal Government, the State of Idaho, and the Province of British Columbia;

"That these United States and Canadian engineers—government and private—who have investigated the reclamation of Kootenay flats *have unanimously concluded* that *the lowering of Kootenay lake* and the waters upstream therefrom during the high water season by means of excavation at the control point in the lake outlet, *is an essential feature* to any successful reclamation of the area in question;

"That four out of seven of the above investigations *concluded that,* in conjunction with the excavation of the outlet, *it was necessary to provide regulating works* at the outlet for the purpose of controlling the outflow during the low water months;

"That the costs for these enlargement and control works were recognized by these investigating engineers as a *fundamental charge upon the reclamation project as a whole.*

(6) "That the proposals of the company *provide for the cost* of the removal of some 250,000 cubic yards of material from the control section in the lake outlet, in addition to the excavation already made by the company during the years 1930 and 1931 at and below Granite, and for the necessary regulation works to control the outflow from the lake, *with no financial contribution on the part of the reclaimed areas.*

(7) "That in 1931, under the provisions of an Act of Congress approved February 12, 1929, the United States Corps of Army Engineers, after making a careful examination of the flood regimen of the river and of conditions obtaining throughout the Kootenay flats and throughout the river reach, both in the United States and in Canada, *and of the storage and excavation proposals of the West Kootenay Power and Light Company,* submitted to the Speaker of the House of Representatives a report upon the Kootenay river, Idaho, with a view to the control of its floods. (United States Army Engineers Report—Canadian Government Exhibit No. 8);

> "That the report of the United States Corps of Engineers to the Secretary of War points out:—
>
> "That the drainage districts in Idaho are subject to over-topping of the dikes during high water;
>
> "That the safeguarding of the drainage districts in Idaho from flooding in high water is dependent upon the enlargement of the outlet of Kootenay lake or, alternatively, the diversion of the Upper Kootenay into the Columbia river through what is known as Canal flats, or a combination of the two—both of which operations must be undertaken in Canada;
>
> "That material raising of the dikes or deepening of the channel in Idaho is infeasible;

"That the reclamation areas in Idaho are at present *probably subject to the possibilities of greater damage from floods during the summer season than from improper drainage of the subsoil due to the raising of the water table during the fall and winter months;*

"That the use of the storage as proposed by the West Kootenay Power and Light Company is desirable for the highest utilization of the potential power in the Kootenay and the *Columbia* rivers, that is to say, in the power reach of the Columbia river lying within the United States;

"Note.—In brief, the report of the Engineers of the United States War Department may be termed to be a complete endorsation of the proposals of the West Kootenay Power and Light Company as beneficial to the drainage interest in Idaho.

(8) "That the Kootenay river is probably the most oustanding example of an international stream along the entire boundary; . . . . that there are a number of international problems connected with this watershed which involve important interests on both sides of the border; that in order that the United States and Canada may realize the development of the full resources of this international river system, *it is essential that there should be the fullest possible measure of mutual co-operation at all points;* that any other policy can only prove mutually hurtful; and that under the Boundary Waters Treaty, the High Contracting Parties have set up the necessary instrument to achieve this mutual co-operation;

"That the report of the United States Corps of Engineers to the Secretary of War points out that the protection of the drainage districts by the enlargement of the lake outlet can be effected only by joint action between Canada and the United States, which action can best be secured through the International Joint Commission.

(9) That there is available below Kootenay lake on the Kootenay river in Canada a total developed and developable head of 348 feet, and on the Columbia river in the United States of some 1,300 feet, which latter head includes the 355-foot Grand Coulee site, the development of which is being placed under way by the Federal and State Governments in connection with the Columbia Basin Project; that the beneficial value of the water stored in Kootenay lake under the company's proposals will be available to Canada and to the United States in proportion to the ratio of the respective heads in either country, i.e., *the benefit to the United States will be nearly four times the benefit to Canada;* that this benefit value is found in an increase of the firm power capacity of the Columbia river in the State of Washington by an amount in excess of 500,000 horse-power, of which 140,000 horse-power is attributable to the Grand Coulee site; and that this benefit value to the United States *is being made available at no cost to the United States.*

(10) "That the Dominion Department of Public Works, which is responsible for the proper preservation of navigation in the waters under consideration in Canada,

"(*a*) believes that the low water conditions will be improved for navigation by the storage proposals of the company;

"(*b*) believes that the alleviation of the high water conditions will also be helpful to navigation; and

"(*c*) accordingly approves the proposals of the company.

(11) "That the Dominion Department of Indian Affairs possesses eight reserves on the Kootenay flats in Canada;

"That that department does not consider that the moderate backing up of the Kootenay river water level at the international boundary by the company's storage proposals during the low water season will, in any wise, injuriously affect the Indian lands on Kootenay flats;

"That on the other hand the department appreciates the benefit which will accrue to these lands by the reduction of the high water stages of Kootenay lake and river as a result of the proposed excavation at Grohman narrows; and

"That the department therefore approved of the company's proposals as submitted to the Commission.

(12) "That all districts *which are interested in the reclamation of Kootenay flats lands in Canada* approve the company's proposals.

(13) "That Mr. A. Klockmann, owner of District No. 5 and owner of a block of land opposite District No. 8 on which he intends to start reclamation, and Vice-President of the Reclamation Company in Idaho, considers that nine drainage districts in Idaho cannot possibly be affected by the company's storage proposals during the low water season and on the other hand considers that, if there were a lower water mark during the high season of say even 1 or 2 or 3 feet, such lowering would be of enormous benefit to the reclaimed districts. He also considers that the lowering which was made effective during the flood season of 1933 as a result of the excavation already completed by the company in the river channel at and below Granite, was of material assistance towards saving the drainage districts from flooding.

(14) "That the diking of drainage districts in Idaho raised the levels of Kootenay lake and river and increased the flood discharge from the lake;

(15) "That the water levels in the ditches and in the sumps of certain of the drainage districts have been held during the low water (proposed storage periods) of 1930-31 and 1931-32 at levels higher than those which are proposed under the company's storage plans and higher than those which would have obtained under free outflow conditions."

Discussion of the Issues. Under the heading "Discussion of the Issues" the Brief points out "that there is complete agreement on both sides of the boundary in respect to the following basic features of the company's proposals:—

"(*a*) That no detrimental effects need be anticipated from the alkali content in the soil;

'(*b*) That the diking of the drainage districts in Idaho has resulted in an increase during high water in the levels of the river reach from Bonners Ferry to Kootenay lake, as well as of Kootenay lake itself, while the increased water level of Kootenay lake has had the effect of increasing the high-water discharge from Kootenay lake;

"(*c*) That the discharging capacity of the dam is amply sufficient to pass the high-water flows without causing any backwater effects;

"(*d*) That the company's storage proposals on Kootenay lake will moderately raise the water levels to the south of the International Boundary during the low-water months;

"(*e*) That the excavation *already completed* at and below Granite permits of the material lowering of the water levels throughout the reclamation reach during high water conditions; that the excavation *of an additional 250,000 cubic yards* of material at Grohman narrows would substantially increase the amount of this lowering in the said reach; that further additional excavation, over and above the excavation of 250,000 cubic yards as now proposed, would be additionally beneficial to the drainage districts;

"(*f*) That the lowering which has already been secured together with that which is proposed is of direct beneficial value to the drainage districts."

It then states:—

"There remains for consideration only one basic feature, i.e. the question as to whether or not the moderate backing up of the water levels during the storage season (i.e. during the months of September, October, November, December, January, February and March), will affect the ground water levels in the drainage districts in such a manner as adversely to affect crop production. *This is the one feature as to which there developed a difference of opinion,* in the material and in the viewpoints presented to the Commission."

The Brief calls attention to the fact that an analysis of the relationship existing between the ground water table of the drainage districts and the adjacent river levels was made by government engineers and presented to the Commission as Canadian Government Exhibit No. 9. It summarizes the general conclusions of this exhibit as follows:—

"1. That the area in which the ground water table is affected by changes in river level is restricted to a more or less narrow strip adjacent to the river and varying in width from 200 to a maximum of 2,000 feet depending on the porosity of the soil and other physical conditions;

"2. That even on the extreme assumption that the water table in the area affected by the river would be raised an amount equal to the proposed increase in river level, the *maximum* level of the water table as shown by the wells in this affected area would be from 9 to 25 feet below the ground surface during the storage period;

"3. That any higher water table which may result from the storage proposals in the area affected by seepage to or from the river will not have any injurious effect on the agricultural value of the land under consideration.

"It is submitted that the analysis embodied in Canadian Government Exhibit No. 9 demonstrates that the ground water levels in those parts of the drainage districts which are located well back from the river or levee areas will not be raised as a result of the company's storage proposals."

On the other hand, the Brief points out that the United States engineers after making a study of the ground water levels in relation to river levels, as described in Newell Exhibits Nos. 9, 10 and 11, reached the conclusion that the company's storage proposals would have the effect of raising the ground water table in certain areas which they termed "critical areas" and that this rise in ground water level would detrimentally affect crop production (Jessup Exhibit No. 2). These "critical areas" which the Brief submits should be called "investigatory areas" are defined in the Newell Exhibits as comprising all lands in which the ground water table was within four feet or less of the ground surface on April 1, 1930.

In summarizing its conclusions with respect to this difference between the findings of the Canadian and United States Government engineers, the Brief states "that the entire question as to possible damage to crops hinges upon the two questions. . . .

"*First.*—Whether or not there are areas that are critical.

"*Second.*—Whether or not the ground water levels in the spring and growing season in such areas will be raised as a result of the company's storage proposals."

With respect to the first question it is pointed out that the so-called "critical areas" were determined at a time when water was being artificially held in the drainage ditches and sumps within the districts and that consequently the existence of critical areas has not been established. It is stated that any conclusions founded upon the extent of the areas as defined or upon the depth to water table within these areas are basically in error.

With respect to the second question it is pointed out that the impossibility of measuring the different factors entering into the "Inventory Method of Analysis," upon which the entire contention, that ground water levels are raised and consequently that damage to crop production will result from the applicant's proposals, is based, makes the application of this method wholly impractical under conditions obtaining in Kootenay flats. Moreover, it is pointed out that there is ample evidence in the United States Government Exhibits "to demonstrate the fact that the 'critical area-to river' seepage theory is wholly unsound and that it does not establish in any degree whatsoever that the ground water levels will be raised in the so-called 'critical areas' as a result of the company's storage proposals."

The Brief then states that "It has, therefore, been demonstrated that nothing has been submitted to the Commission which in any degree whatsoever impairs the conclusions reached in the Canadian Government Exhibits Nos. 9, 10 and 11, to the effect that the company's storage proposals will not raise the ground water levels in the drainage districts in any manner as to injuriously affect the agricultural value of the land."

It therefore follows that "inasmuch as no rise is to be anticipated in the ground water table in the so-called 'critical areas' as a result of the company's storage proposals in the low water season, the conditional conclusions reached in the Jessup Exhibit, as to possible damage to crop production, have no application to the districts and do not enter into the problem which is before the Commission."

With regard to the holding of water in the ditches and sumps of certain of the drainage districts the Brief states: "These higher levels in the ditches and in the sumps must have been so held knowingly and purposely by the district owners. There can be only one possible reason for the holding of these sump and ditch levels at these higher elevations and that reason is that, as a result of such holding, it was anticipated that the crop production would be bettered. No representations have been made that the crops in these districts have been other than satisfactory. That the effects of holding the water *were* satisfactory is demonstrated by the fact that water was held during each year of the investigation.

"The Commission is therefore in the fortunate position that it does not have to form its opinion upon an analysis based upon theory and assumption. Nor is it necessary for the Commission to depend upon future demonstration. *Actual demonstration* of the effect of holding the water table at higher elevations than are to be anticipated from the company's storage proposals *have already been carried out on a widespread basis throughout the reclamation area in Idaho by the district owners themselves.*

"It is finally submitted, therefore, that apart altogether from theoretical deductions as to whether or not the company's storage proposals will have the effect of raising the water table in the drainage districts, the practical effect of such raising upon crop production has already been completely demonstrated in many of the districts and that such effect is beneficial rather than detrimental to crop production. It is submitted that no further practical demonstration is required."

Further to the discussion of the issues in the main body of the brief there are attached to it three appendices in No. I of which the Inventory Method of Analysis is discussed in greater detail and in No. II of which the benefit value to Idaho interests of lowering the flood levels of the Kootenay river is discussed while in No. III certain phases of the representations made on behalf of the State of Idaho are considered.

Miscellaneous Phases. Under the heading "Miscellaneous Phases" the brief gives further consideration to certain items as follows:—

With regard to possible further excavation at the lake outlet it states:—

"It is submitted that, with the 250,000 cubic yards removed and the beneficial effects accruing therefrom realized by the drainage districts, the way is open to effect arrangements for additional excavation for the further benefit of the drainage districts. This is a matter of vital import to the entire problem of the successful reclamation of Kootenay flats.

"It may also be noted that if in the operation of the storage scheme it is found that the 250,000 cubic yards of excavation from the Grohman narrows is not sufficient to ensure that the level of Kootenay lake is reduced to the average low water mark at the time of the beginning of the spring freshet, the company undertakes to excavate such additional yardage as will accomplish this result. (Transcript 499.)"

With regard to the higher water levels in Kootenay river and lake as a result of diking the drainage districts in Idaho it states:—

"This feature is brought to the attention of the Commission in order that two phases may receive its consideration.

"The *first phase* which merits consideration in respect to this matter is the fact that the diking of the districts has resulted in raising the high water level in flood time in the river adjacent to the districts and this fact makes even more essential to the districts the relief and benefit which will be experienced by lowering the high water conditions by means of the excavation at Grohman narrows.

"The *second phase* is that the increase in water levels and in river discharge from the lake has resulted in increased costs in the reclamation of Kootenay flats lands in Canada because of the higher dikes required, the increased pumping requirements and the generally greater possibility of failure, and also in increased costs in the construction of power undertakings on Kootenay river below Kootenay lake in order to provide for additional flood discharge capacity. Under Article II of the Boundary Waters Treaty Canada would have a claim for damages against the drainage districts in Idaho for the injury which has resulted to Canadian interests from the higher levels and the greater discharges which have resulted from the diking of the said drainage districts."

With regard to the broader international phases it states:—

"It is only through the instrumentality of the International Joint Commission, the body created by the Governments of Canada and the United States for this express purpose, that the advantageous utilization of the resources of the Kootenay river watershed, in the best interests of both countries, can be realized. It is therefore necessary that, in considering this application, the river system as a whole should be kept in mind."

With regard to the benefit of stored water to power in the United States the brief states:—

"The beneficial value to the power resources of the Columbia river located in the United States is almost four times the benefit to the power resources of the Kootenay river located in Canada. The firm power capacity of the Columbia river in the State of Washington will be increased by an amount in excess of 500,000 horse-power. Of this amount 140,000 horse-power is attributable to the Grand Coulee site now in course of development by the Federal and State Governments. In this connection also, reference might be made to the public announcements which have been made since the date of the hearings to the effect that the development of a further site on the Columbia river at Bonneville, where a head of some 62 feet will be utilized, has been placed under

way by the Federal and State Governments, and that the United States Public Works Administration has allotted the sum of $20,000,000 for the construction of the undertaking.

"As has been established before the Commission, the increased firm power which is being made available to the United States on the Columbia river, is being made available at no cost to the United States.

"It is submitted that in appraising the economic effect in the United States of the company's proposals, the Commission must take cognizance of the immense benefit value, to the power resources on the Columbia river in the State of Washington, resultant from such proposals."

Conclusions and Recommendations. The conclusions and recommendations contained in the Brief are repeated herewith in their entirety:—

"The difficulties that confront the International Joint Commission in dealing with such complicated and technical issues, are fully appreciated. It is thought, however, that they can be simplified and thus rendered capable of solution by considering certain essential points.

"It is clear that the project, considered as a whole, is one that should commend itself to the Commission. No serious argument has been advanced that would justify the frustration of the development of the Kootenay-Columbia system, the greatest potential source of wealth to the northwest of the United States and the southwest of Canada. The only contested question before the Commission is the single, but complicated, issue,—whether the project is, on the whole, beneficial or detrimental to the reclamation districts and areas capable of reclamation in Canada and the United States.

"If the project is on the whole beneficial to the Idaho interests, it follows that the application should be granted, with proper safeguards. If the project is on the whole detrimental to the Idaho interests, it follows that the application should only be granted with specific provisions for indemnity.

"Accordingly, it becomes necessary to consider the balance of benefit and detriment from the point of view of the Idaho interests.

"On the *credit* side, the project shows a lowering of flood levels and a certain appreciable lessening of danger to the dyked districts. This is undisputed. Its value has been minimized by certain of the landowners but, in view of the overwhelming testimony presented in the reports of eight separate engineering investigations, extending over practically fifty years and culminating in the report of the United States Corps of Army Engineers in 1931, it is submitted that it is a credit item of first magnitude. These reports demonstrate that it would have been worth while for the reclamation interests to have expended their own moneys in excavating Grohman narrows and erecting a control dam in order to secure the benefit of lowered flood levels. The carrying out of this work by the applicant, at no expense to the reclamation interests, is an asset worth many hundreds of thousands of dollars.

"On the *debit* side, the project shows certain but limited increase in autumn and winter river levels, with a possibility of detrimental effect upon the riparian lands. The question of whether there will be detrimental effect upon riparian lands is a matter of inference and conjecture, and is incapable of definite proof. It is submitted that the Commission should accept the views of Messrs. Meek and Dawson and the result of their investigations conducted on behalf of the Canadian Government in this matter. Their views are largely confirmed by the fact that in the so-called 'critical areas' the water tables have not responded during the period of investigation, in any respect, to changes in river levels.

"Even if the International Joint Commission were of the opinion that the raising of the river levels during the storage season might affect ground waters

in the so-called 'critical areas,' it should be pointed out that no real attempt has been made to evaluate the possible detriment that might thus be occasioned. If the views of Mr. Newell and Mr. Jessup are accepted in their entirety, the true measure of detriment to the Idaho interests would be the amount of money that would be necessary to provide for the increased pumping. No evidence has been presented as to pumping costs, and no estimates have been given as to the additional pumping that would be necessary to compensate for any possible effect the storage regime might have upon ground water conditions. It is submitted that the Commission would be justified in concluding that the measure of detriment would be a comparatively trivial amount, and certainly not an amount comparable, when measured in dollars and cents, to the valuable assets presented on the credit side of the account.

"In the evidence as presented to the Commission there has been only one attempt made to give expert evidence as to the balancing of certain benefits on the one hand, and possible detriment on the other. That is to be found in the report of the United States Army Corps of Engineers, 1931. The engineers in that case had under consideration both the benefit to the reclamation interests of lowered flood levels and the possible effect upon conditions in Idaho of the increased levels during the storage period. Their conclusions as to the balance of advantage or disadvantage are expressed in the statement which is quoted on page 64 of the Brief and which may be repeated:—

> '94.—In connection with the dam and compensatory works proposed by the West Kootenay Power and Light Company, it seems that the use of storage as proposed is desirable for the highest utilization of the potential power in the Kootenai and in the Columbia, and the compensatory works will be of benefit during flood stages to all overflow lands in the valley above the lake, in Canada as well as in the United States, in that it will increase the discharge capacity of the river.'
>
> '95.—The reclaimed areas in Idaho are at present probably subject to the possibilities of greater damage from floods during the summer season than from improper drainage of the subsoil due to raising the water table during the fall and winter months.'

"It is submitted on behalf of the Canadian Government that the Commission should accept the position set forth above, particularly the conclusions of the United States Army Corps of Engineers and find that the project is on the whole beneficial to the Idaho interests, and that consequently there should be no provisions of any sort in the order for indemnity.

"On the other hand, it is recognized by the Canadian Government that the beneficial effect of the company's project during the flood period and the minimizing of the possible detriment during the winter period, are dependent upon the operation of the company's program along the lines set forth in the application and presented to the Commission. It is recognized that the Idaho interests should be entitled to some guarantee that the regime of regulation and control will be carried out with due regard to their position. Further, while it is recognized that the Company cannot fairly be called upon to undertake any further financial obligation in the interests of the reclamation areas in Idaho and Canada and of the unreclaimed lands, the Commission should nevertheless take this opportunity of preserving the possibility of effecting further improvements in flood level conditions in the districts both in Canada and in the State of Idaho.

"Accordingly, it is submitted that the Commission in its Order authorizing the company's project, should include the following provisions:—

"*First.*—To ensure that the reclamation interests in the Kootenay flats in British Columbia and in the State of Idaho should obtain the benefits

accruing from the project, there should be inserted in the Order a condition that the regime of storage should be authorized only upon the completion by the Company of the proposed excavation of 250,000 cubic yards at Grohman narrows.

"*Second.*—It should also be provided that the company place on record an undertaking that, without any further financial responsibility, the Company should co-operate and assist in any measures that might be undertaken under the authority of the two Governments, with a view to further channel enlargements designed to improve flood water conditions in the Kootenay flats, both in the Province of British Columbia and in the State of Idaho.

"*Third.*—To ensure that the full benefit from the excavation accrues to the reclamation interests it should be provided that, throughout the period of flood flow in each and every year, a sufficient number of gates and sluiceways of the dam should be open to provide, in conjunction with the flow through the plant, for the maximum possible outflow from Kootenay lake.

"*Fourth.*—To ensure that the storage proposals are not exceeded it should be provided that, throughout the period of seasonal low flow in each and every year, the gates of the dam must be so operated that the Kootenay lake level does not rise above the maximum storage line laid down on the Company's Plan No. F-239 dated February 27th, 1932, except under unavoidable natural high inflow conditions when sufficient gates must be open and remain open throughout such period of excess to provide the maximum possible outflow from Kootenay lake.

"*Fifth.*—To ensure that dependable basic data will be available to check the company's operations, it should be provided that the company shall maintain four (4) automatic gauges in a manner and at locations and of a type satisfactory to the commission, as follows:—

1. In Kootenay river at tailrace of power plant,
2. In Kootenay river at forebay of power plant,
3. In the West arm of Kootenay lake at Nelson, or at the head of Grohman narrows,
4. On Kootenay lake in vicinity of Queens bay near lake outlet,

and that the records from these gauges shall be regularly made available to and filed with such authority as the Commission may direct, and further that the company shall make available to the Commission such data having to do with the discharge through the Corra Linn dam or power house or having to do with the power load, as the Commission may consider to be necessary to enable it to ensure the observance of the provisions of its order.

"*Sixth.*—It should also be provided that the cost of maintaining all parts of the dam and all sluices and log sluices and automatic gauges shall be borne by the owners thereof, and that this work and maintenance shall be done in a manner satisfactory to the Commission.

"*Seventh.*—It should be provided that the excavation for the enlargement of Grohman narrows as required under the first provision in the foregoing, and the regulation of the flow of water through the Corra Linn dam to the extent required under the third and fourth provisions in the foregoing, should be subject to the supervision and control of an officer appointed by the Government of Canada and reporting to the Commission, and that there should be associated with him as adviser, an officer appointed by the Government of the United States and charged specially with the duty of recommending such action as might be necessary to preserve the interests of the reclamation districts in the United States."

SUMMARY OF BRIEF FOR THE GOVERNMENT OF THE UNITED STATES ANSWERING BRIEF OF WEST KOOTENAY POWER AND LIGHT COMPANY, LIMITED, DATED JANUARY 10, 1934, AND BRIEF FILED ON BEHALF OF THE GOVERNMENT OF CANADA, DATED JANUARY 5, 1934.

In the Introductory of the Brief of the West Kootenay Power and Light Company, Limited, the applicant, reference is made to the original application of September 6, 1929; to the hearing which took place at Bonners Ferry, Idaho, on November 6, 1929; to the amended application dated February 8, 1932; and to the hearing which took place at Nelson, British Columbia, on August 24 to 26, 1933.

It is therefore unnecessary herein to trace the course proceedings in this matter have taken.

General Issues of Fact. The original application of September 6, 1929, to construct and operate a dam at Granite, British Columbia, contained with reference to the effect of the operation of the dam the following statement:—

"The company respectfully submits that this will not have any injurious effect on any interests in the United States or any state thereof." The statement quoted will be found at page 9 of the original application.

At the hearing at Bonners Ferry on November 6, 1929, Mr. Crowe, appearing before your Commission in behalf of applicant, stated:—

"On behalf of the applicant I wish to say that if we were not absolutely convinced by the investigations we have made that we were going to help this part of the State of Idaho to build up a still greater population, if we were not going materially to assist its prosperity and could not absolutely prove it to this Commission, it might be objected as unreasonable to expect sixty days' notice would be sufficient, if that were all the notice that had been given." Transcript, Bonners Ferry Hearing, November 6, 1929, page 31.

Mr. Crowe stated further at Bonners Ferry, page 35, Transcript, the following:—

"I think it is reasonable that we should be allowed to show him that they are not going to be injured, but are going to be benefited." . . . "We are not going to injure but we are going to benefit the State of Idaho."

In the amended application of February 8, 1932, it was stated:—

"The company respectfully submits that the said works completed and proposed and the method of operation of the dam as proposed by the company will not have any injurious effect on any interests in the United States or any state thereof."

The State of Idaho and Drainage Districts Numbers 1 to 11, responding by the Honorable W. D. Gillis, Attorney-General of Idaho, Mr. Fred J. Babcock, Assistant Attorney-General, and Mr. O. C. Wilson, Counsel, to the application of September 6, 1929, stated in paragraph III of the affirmative response as follows:—

"That should the proposed project of the West Kootenay Company be constructed, irreparable injury would be caused to the lands of your respondents within the State of Idaho."

Mr. O. C. Wilson made the following statement at the hearing at Bonners Ferry:—

"We have not considered this matter from the point of view of any slight damage inflicted upon us, but what we have in mind is that we are going to be irreparably injured." Transcript, Bonners Ferry Hearing, page 34.

The view that irreparable injury would result from the operation of the dam at Corra Linn was asserted anew in the response made to the amended application by the Honorable Bert H. Miller, Attorney-General of Idaho, and Mr. O. C. Wilson.

Rule of the Case. The general issues developed in the pleadings and orally before your Commission are apparent from the foregoing.

Attention is now called to Article VIII of the Convention of 1909 by which article jurisdiction is conferred upon your Commission. The first paragraph and the next to the last paragraph of that article are quoted because of their bearing on the issues presented. These paragraphs read:—

> "This International Joint Commission shall have jurisdiction over and shall pass upon all cases involving the use or obstruction or diversion of the waters with respect to which under Articles III and IV of this treaty the approval of this Commission is required, and in passing upon such cases the Commission shall be governed by the following rules or principles which are adopted by the High Contracting Parties for this purpose:—
>
> . . . .
>
> "In cases involving the elevation of the natural level of waters on either side of the line as a result of the construction or maintenance on the other side of remedial or protective works or dams or other obstructions in boundary waters or in waters flowing therefrom or in waters below the boundary in rivers flowing across the boundary, the Commission shall require, as a condition of its approval thereof, that suitable and adequate provision, approved by it, be made for the protection and indemnity of all interests on the other side of the line which may be injured thereby."

These treaty provisions are unambiguous. Their meaning is clear. The first paragraph clearly confers on your Commission jurisdiction to grant or to refuse to grant permission to operate, in such manner as to affect the natural level of the waters above the boundary, a dam at a lower level than the boundary in a stream crossing the boundary. There can be no doubt that the construction, maintenance and operation of the dam at Corra Linn are within the jurisdiction of the Commission as conferred by Article VIII.

It is respectfully observed that it is equally clear that the first paragraph prescribes rules by which your Commission is to be governed in exercising the jurisdiction conferred upon it. It is clear that the rule for the present application is found in the next to the last paragraph of that article. The rule applicable to the pending application is,

> "The Commission shall require, as a condition of its approval thereof, that suitable and adequate provision, approved by it, be made for the protection and indemnity of all interests on the other side of the line which may be injured thereby."

This rule requires that before the pending application can be approved, suitable provision and adequate provision shall be made by applicant for the protection and indemnification of all interests in the United States that would be injured.

This rule seems to require a decision whether injury would or would not be caused by the operation of the dam at Corra Linn to interests in the United States if the dam were operated in low water season as proposed in the application. If your Commission should be able to conclude that there would be no injury, there would be no obstacle in the treaty to authorizing the operation of the dam as proposed in the application. There would be no necessity to consider whether there would be any benefits. If your Commission should conclude that interests in the United States would be injured, it is respectfully

insisted that the rule prescribed in the Convention would require that suitable and adequate provision for indemnity be made by applicant and that the provision for indemnity be approved by your Commission before permission to operate the dam should be granted.

The applicant is before your Commission seeking the favour of its approval. The question arises whether the applicant has shown that your Commission would be justified in granting the permission sought; whether the applicant has complied with the requirements of the Convention of 1909. Unless your Commission concludes that interests in the United States would not be injured by the operation of the dam as proposed in the application, the applicant should be required to make suitable and adequate provision for indemnity. Suitable and adequate provision for indemnity should be approved by your Commission before permission is granted to maintain or operate the dam.

Until suitable and adequate provision for indemnification of all interests in the United States which would be injured by the operation of the dam as proposed by applicant is made by applicant, whatever the making of such provision would entail, and the provision for indemnity so made is approved by your Commission, the permission sought by applicant should not, in view of Article VIII of the Convention of 1909, be granted.

The brief of applicant is summarized as follows:—

Response to the titles of applicant's brief: Introductory, The Amended Application, The Applicant's Evidence, Applicant's Works and Interests on River, Agencies Contributing to Higher Flood Levels and Lower Minimum Flow, is made at page 7 of the United States Brief. (Brief comment is made concerning (1) inadequate phases of applicant's statement concerning the utility of the control features of the Corra Linn Dam as constructed, irrespective of its possible future use as a storage dam and (2) the relative importance of Grohman Narrows as a factor in controlling the level of Kootenai Lake.)

The following titles of Applicant's Brief under the heading Flood Relief are discussed at page 8 of the United States Brief: Enlarging Grohman Narrows to Reduce Flood Levels, Discharge Capacity of Dam and Power House. In reference to the topic: Effect of Enlarging Grohman Narrows and Other River Improvements, under the same heading, there are discussed and compared, pages 8 to 12 of the United States Brief, the results of such effect as calculated by the three groups of engineers: of the applicant, of the Canadian Government, and of the United States Government, respectively. Argument is made for the reasonableness and trustworthiness of the results obtained by the United States Government engineers.

With reference to the title in Applicant's Brief: Beneficial Results to Idaho from Flood Relief—there are discussed the matters of the reduction of loss and damage in Idaho that would result from the lowering of flood stages due to applicant's proposed works. After considering some phases of the matter in detail, the following concluding statement is made (pp. 14 and 15):—

> "That flood levels of the river in Idaho would be reduced as a result of the applicant's works, provided of course that the dam would be operated so as to admit of more rapid escapement of water than can occur under present conditions, is not disputed.
>
> "That benefits which have not been precisely defined would accrue to lands in Idaho as a result of the lowering of flood levels is not disputed. Whether benefits would or would not accrue is deemed to be immaterial to a decision on the pending application. The position here stated will be amplified later herein."

Pertinent to the title, Earlier Investigations, there are presented essential features of plans for reduction of flood levels and reclamation of the lowlands

of Kootenai Valley as developed in the earlier investigations. Attention is drawn to the scope of applicant's proposals in relation to those preceding. The discussion of this topic concludes as follows (page 20):—

> "While benefits would undoubtedly accrue in Idaho from applicant's works at the outlet of the lake and in the river, the record is barren of evidence that those works, even if allowed to register their maximum effect in Idaho, would constitute a large factor in the solution of the problems with which reclamation interests in Idaho are confronted.
>
> "In view of the difference between the amount of earth which engineers recommended should be removed from the outlet of the lake in aid of reclamation and the amount applicant proposes to remove, the plans of applicant cannot be regarded as a large factor in reclamation."

Under the general heading of Storage there are treated various phases of the subject as presented in Applicant's Brief. Under the title: Raised River Levels During Storage, exception is taken to the trustworthiness of the increases in stage as indicated by certain of applicant's results. With respect to: Effect of Increased Levels During Storage Period, various views and statements of applicant concerning the influence of higher river levels on seepage between the river and the lands are discussed and argument based upon opposing evidence is presented. The following conclusion is expressed (pp. 26 and 27):—

> "It may be said in concluding the comment under this title that the dominant factor in any consideration of the effect of increased levels during the storage period would be, how would the water table in the critical areas be affected by maintaining the water in the river at higher levels in the storage period than they are under present conditions? The premises employed in Applicant's Brief in discussing this title do not support the conclusion that 'this strip of land with such an ample margin between the level of the high storage line and the level of the surface of the ground will be an absolute impediment to the seepage of water from the river to the lower lands beyond this strip.'
>
> "Finally, it should be said that there has been no admission on the part of the Government of the United States that the proposition quoted is sound. The proposition remains to be proved."

The following paragraphs open the discussion of the topic: Encroachment of Storage Levels upon Sluice Gates (page 27):—

> "The statement made in Applicant's Brief in opening the discussion under this title that the increased elevation of the river could not get through the elevated land arrests attention.
>
> "The dominant question in the study of the effect of maintaining higher levels in the river is whether the water table in critical areas would be higher because of the storage than it is under present conditions. It may be asserted as an elementary principle that if the water in the river is maintained at a higher level than the water table, water will seep from the river to the land. Unless the operation of natural laws would be interrupted in these drainage districts, water would enter or be held in the critical areas as a result of storage. The water table in the critical areas would be correspondingly higher."

Applicant's general observations concerning the subject are considered and the relation of the lowest land in five drainage districts—Districts Nos. 8, 6, 11, 7, and 1—to the proposed storage lines as indicated by United States evidence is considered in detail and contrasted with the statements of applicant with respect to encroachments of the storage lines on the sluice gates of the specified districts. The discussion contains the following summary statement (page 38):—

"Districts 8, 6, 11, 7, and 1 are understood to have been selected by applicant for comparison of relation of lowest lands to the storage levels in the river because sluice gates in those districts would be encroached upon in storage periods. Absence of encroachment on sluice gates does not indicate that elevation of river levels in storage periods would not result in injury to lands in the drainage districts. Comparisons of elevation of lands in Districts 8, 6, 11, 7, and 1 with storage levels do not show that injury to lands in these districts, or in any other district, would not result from the elevation of river levels in storage periods.

"The plan employed in Applicant's Brief of eliminating the possibility of injury disregards the river as a natural drain, the position of the water table with reference to the surface of the land and the position of the water table with reference to levels of the river and disregards the natural law that water will seek its own level."

General comment is presented on applicant's discussion of Relation of Lowest Land to Storage and the conclusion is expressed that (page 41):—

"The apparent purpose of this section of the Applicant's Brief is to show a picture of the elevation of the lands in drainage districts Nos. 8, 6, 11, 7, and 1, which belittles the acreage in each subjected to injury by encroachment of regulated river levels directly through the outlet gates, and ignores the fact that subdrainage from land to river will be retarded."

Consideration is given to applicant's discussion of the title: Objections to Application. With respect to the first subheading: The Critical Areas, the Brief deals with applicant's complaints concerning the scope of the Newell-Jessup investigations, and its premise that such investigations were based on data determined at a time when water was being held within the sumps and drains of the district. The Brief treats at some length evidence tending to show that applicant's complaints on these points are misdirected and without foundation.

Relative to the second subheading: The Inventory Method of Analysis, the objections of applicant to this method as applied by Mr. Newell are considered both in general and in detail. The following statement summarizes the general position on this matter as taken in the United States Brief (page 60):—

"Mr. Newell collected data to determine surrounding conditions, analysed the data and applied to them established and accepted principles. Until the data collected by him are shown to be undependable; until the principles applied by him are shown to be inapplicable; until the reasoning employed by him is demonstrated to be faulty, the conclusions reached by him are entitled to the earnest consideration and to the respect of your Commission."

Several of the factors in the Inventory Analysis are discussed in detail to meet criticisms of applicant.

Applicant's criticisms of the Newell-Jessup studies under the heading: Conditions Prevailing in the Drainage Districts During the Newell Critical Area Study are treated to satisfy questions raised with regard to the reliable significance of results obtained in the studies. The United States Brief maintains that the position of applicant on this point does not accord with the evidence.

Beginning at page 79, the United States Brief comments upon applicant's Exhibit No. 4, a report by Fred Mathews, entitled: Discussion of the Water Table in its relation to the River, Foothills and Drain Ditches. By a critical examination of the subject matter of the report the Brief tends to show that the conclusions of the report are not well founded.

On pages 113 to 118 the evidence and Brief of the Canadian Government are briefly considered. The concluding statement follows:—

"It would unduly prolong this answer to follow through in detail the evidence presented at the hearing by the Canadian Government and the Brief filed on behalf of the Canadian Government. The evidence and brief will, it is believed, be sufficiently searched by the foregoing and by the following discussion of the conclusions stated by the Canadian Government and by the applicant."

Conclusions. For convenience of discussion, the conclusions reached by applicant and stated beginning at page 97 of the Applicant's Brief will be broken up and will be mingled with conclusions stated in the Canadian Government Brief, as follows:—

1. "The flood relief afforded to the reclamation districts in Idaho has been proven and admitted to be substantial."

A similar conclusion is stated in behalf of the Canadian Government as follows:—

"On the credit side the project shows a lowering of flood levels and a certain appreciable lessening of danger to the diked districts. This is undisputed."

This statement is found at page 76 of the Brief of the Canadian Government:—

2. "Engineers for the interested governments and otherwise in the past have advocated the carrying out of the improvements at Grohman narrows and the erection of control works below Grohman narrows as a fundamental feature of any successful reclamation of the low lands of Kootenay Valley in Idaho and British Columbia, the expense of which would be a charge against the lands reclaimed. Such improvements and control works will be provided in the present scheme of the applicant without cost to the reclamation interests." . . .

"Two paragraphs from Canadian Government Exhibit 8, being a report from the Chief of Engineers, U.S. Army, Document No. 157 of the 72nd Congress, First Session, House of Representatives of the United States, now quoted by me from page 29, constitute an appropriate summary:

"'94. In connection with the dam and compensatory works proposed by the West Kootenay Power and Light Co., it seems that the use of storage as proposed is desirable for the highest utilization of the potential power in the Kootenay and in the Columbia, and the compensatory works will be of benefit during the flood stages to all overflow lands in the valley above the lake, in Canada as well as in the United States, in that it will increase the discharge capacity of the river.

"'95. The reclaimed areas in Idaho are at present probably subject to the possibilities of greater damage from floods during the summer season than from improper drainage of the subsoil due to raising the water table during the fall and winter months.'"

The earlier recommendations of engineers that excavations be made at Grohman narrows as a reclamation measure are regarded by the Canadian Government as of first magnitude. Page 77, Brief of Canadian Government.

The Canadian Government in stating conclusions places emphasis on the report of the Board of Engineers and quotes the same paragraphs of the report as are quoted above from Applicant's Brief.

3. "The evidence of the applicant and of the Dominion of Canada has shown that no injury will be done to the reclamation districts or any other interests by the increased levels of Kootenay river in Idaho during the storage period."

The following may be quoted from page 46 of Applicant's Brief in further relation to conclusion 3:—

"Assuming, for the moment, that the Newell and Jessup studies of the critical areas are representative, I contend that they indicate that the land bordering the critical areas contain many acres which would be benefited by a moderate rise in water table and that had the bordering lands been included in the investigation, as they should have been in order to present the complete story to the Commission, the net damage in each district would be greatly decreased."

"The act of holding water in the drainage ditches and within the so-called critical areas must of necessity raise the water table within these adjacent areas."

The following statement is made in behalf of the Canadian Government:—

"The only contested question before the Commission is the single, but complicated, issue,—whether the project is, on the whole, beneficial or detrimental to the reclamation districts and areas capable of reclamation in Canada and the United States.

"If the project is on the whole beneficial to the Idaho interests, it follows that the application should be granted with proper safeguards. If the project is on the whole detrimental to the Idaho interests, it follows that the application should only be granted with specific provisions for indemnity.

"Accordingly, it becomes necessary to consider the balance of benefit and detriment from the point of view of the Idaho interests."

The foregoing statements are found at page 76 of the Brief of the Canadian Government.

4. "The evidence produced by any party objecting to the application has failed to prove that any injury will be done, the data on the record showing that there will be no injury from the storage levels and that the conditions existing during the period of study have been worse than the conditions that will prevail when storage is in effect."

The following quotations from pages 48, 58 and 59 of Applicant's Brief are herein associated with this conclusion:—

"A study of this method indicates that in order to obtain representative results not only must all contributing and dissipating factors be taken into account but an accurate value must be applied to each item. I contend that in the analyses under discussion this accuracy is missing and that the very nature of the problem and the conditions obtaining in the Kootenay valley make its attainment wholly impracticable." . . .

"It is therefore my contention, as amply supported by the foregoing, that the inventory method of analysis is not applicable to the Kootenay valley and that the results obtained in the Newell Exhibits being dependent upon this method are in the last analysis merely assumptions which the results of studies of engineers of the Dominion Government and of the applicant show to be in serious error." . . .

"And, in effect, has completely destroyed the theoretical conclusions reached in the Newell and Jessup Exhibits that any detrimental effect on crop production in the districts could be caused by the Company's storage proposal."

The following statements are made in the Brief of the Canadian Government:—

"The question of whether there will be detrimental effect upon riparian lands is a matter of inference and conjecture and is incapable of definite proof." . . .

"Even if the International Joint Commission were of the opinion that the raising of the river levels during the storage season might affect ground waters in the so-called 'critical areas,' it should be pointed out that no real attempt has been made to evaluate the possible detriment that might thus be occasioned. If the views of Mr. Newell and Mr. Jessup are accepted in their entirety, the true measure of detriment to the Idaho interests would be the amount of money that would be necessary to provide for the increased pumping. No evidence has been presented as to pumping costs and no estimates have been given as to the additional pumping that would be necessary to compensate for any possible effect the storage regime might have upon ground water conditions."

The foregoing statements will be found at page 77 of the Brief of the Canadian Government.

5. "Substantial benefit will ensue to power interests in the State of Washington, from the storage of water in Kootenay lake as applied for."

6. "No damage will be done and no additional expense will be incurred by Idaho interests. Substantial benefit will accrue to all United States interests, therefore the applicant most respectfully requests that this Honourable Commission grant its application."

These conclusions will now be discussed in numerical order and a position will be stated with respect to each of them.

Statement of Position. 1. The conclusion is stated in Applicant's Brief that flood relief would be afforded to reclamation districts in Idaho. A similar conclusion is stated in the Brief of the Canadian Government.

This relief presumably would be derived from the lowering of the flood stages of the river as a result of enlarging the outlet of the lake and of river improvements. This general subject was discussed at some length under the title "Beneficial Results to Idaho from Flood Relief" beginning at page 12 thereof. Further extensive discussion is deemed unnecessary.

It may be said, however, that the precise benefits which reclamation districts would experience have not been defined. These benefits have been stated to be protection against flooding by breaking or overtopping of dikes and reduction in seepage from the river into the drainage districts. There can be no doubt that by lowering the flood stages of the river, whether the amount of lowering found by the United States engineers, the amount found by the Canadian Government engineers, or the still greater amount found by applicant's engineers, are considered, there would be less pressure on the dikes every year, the dikes might not be overtopped some years in which they would be overtopped if the outlet of the lake were not enlarged, and there would be less seepage into the drainage districts than there is under existing conditions.

The benefit of relief from pressure on the dikes cannot be measured in money. It cannot be determined how frequently or for what acreage flooding of lands would be averted by lowering the flood stages of the river as proposed. Likewise it cannot be determined how frequently or in what districts overtopping of dikes would be averted. While reduction of seepage into the districts might be appreciable, seepage from the river in the high water season has not been regarded as extensively injurious, if injurious at all.

While undoubtedly some elements of benefit would be derived from flood relief, it can be asserted with confidence that however these elements of benefit might find expression the damage resulting from inability to sow at seeding time and from the drowning of crops in the critical area which it is maintained would result from too high a water table caused by storage could not be cured by relief from pressure on the dikes, from overtopping and from reduced seepage

in flood season. Crops which could not be planted and crops which were drowned in the critical area before flood stages arrived would not be benefited by flood control.

The damage caused by storage through raising the water table in the critical area would not be cured by flood control.

2. The subject of the second conclusion is fully discussed under the title "Earlier Investigations" beginning at page 15 of the United States Brief. Little additional space need be devoted to this subject.

Comment is in order, however, on paragraphs 94 and 95 of the report of the Board of Engineers for Rivers and Harbors. These two paragraphs are quoted on page 98 of Applicant's Brief. The same paragraphs are quoted on page 78 of the Brief of the Canadian Government.

Two points are made in paragraph 94. The first point is that the dam and compensatory works are desirable for the highest utilization of the potential power in the Kootenay and in the Columbia. The second point is that the compensatory works will be of benefit during the flood stages to all overflow lands above the lake, in Canada as well as in the United States.

The first point need not be discussed except as to power potentialities on the Columbia in the State of Washington. This subject constitutes conclusion five. This point will be dealt with in discussing conclusion five.

The second point has been adequately dealt with at pages 8 to 15 and at pages 122 to 124 of the United States Brief.

In turning to paragraph 95 of the report of the Board of Engineers, it may be said that it cannot be emphasized too strongly that this paragraph has no relation to the effect of storage on drainage. This paragraph clearly speaks as of the date of the report, that is "at present," and was comparing possibilities of damage from flood during the summer season with possibilities of damage from improper drainage in winter under conditions as they were at the time the report was rendered. This paragraph did not compare possibilities of damage from floods in summer with possibilities of damage from improper drainage in winter under storage conditions. This paragraph contains no expression of views of the Army engineers on the probable effect of storage.

The Army engineers did, however, in paragraphs 87, 88 and 91 of the report, express views on the effect of the proposed storage on drainage and seepage. These paragraphs are quoted at pages 19-20 of the United States Brief. These paragraphs clearly indicate that the Army engineers were of the opinion that the proposed storage would be injurious to reclamation interests in the United States. Neither these paragraphs nor paragraph 95 indicate that the Army engineers were of the opinion that under storage conditions reclaimed areas in Idaho would be subject to greater damage from floods than from improper drainage.

3. The third conclusion and the statements from the Brief of Applicant and the Brief of the Canadian Government associated therewith raise two points:—

(*a*) Has applicant and the Dominion of Canada proved that no injury would be done to the reclamation districts or to other interests in Idaho by raising the levels of the river in the storage period?

(*b*) Is it material to a decision on the pending application whether benefit would accrue in the United States?

With respect to (*a*) above it may be said that if your Commission is prepared to accept the conclusion that the evidence of applicant and of the Government of Canada shows that no injury would be done to the reclamation districts if the proposed storage were permitted, there would be little basis for argument against favourable action on the pending application. While in contemplation of law, raising water adjacent to the lands of riparian owners

in itself constitutes damage, this technicality, in view of the rule of the case found in Article VIII of the Convention of 1909, could not well be urged against favourable action on the application.

It must be obvious, from the basic data and the interpretation thereof presented to your Commission by Messrs. Newell and Jessup, that it can not be conceded that applicant and the Canadian Government have shown that injury would not be done in Idaho if storage were permitted in accordance with the application. Notwithstanding the attempt which has been made to discredit the Newell and Jessup studies, it is maintained that those studies show with as much certainty as can characterize studies of this kind that a large acreage of land would be seriously injured as a result of the storage.

With respect to (*b*), the position is reiterated that whether benefits would accrue to interests in the United States from the execution of applicant's plans is wholly immaterial to a consideration of the pending application.

It was emphasised early herein that the rule of this case is the first paragraph and the next to the last paragraph of Article VIII of the Convention of 1909. The rule there imposed is that

> "the Commission shall require, as a condition of its approval thereof, that suitable and adequate provision, approved by it, be made for the protection and indemnity of all interests on the other side of the line which may be injured thereby."

The application of this rule necessitates a determination whether the operation of the dam as proposed for storage purposes would or would not cause injury in the United States. Obviously provision for indemnity could not be made or approved without first determining whether there would be injury and without defining the injury for which indemnity should be provided. If the Commission finds itself in position to conclude that there would be no injury, provision for indemnity would of course be unnecessary. It would obviously be immaterial whether there would be benefit. Should the Commission conclude that there would be injury, approval of provision for indemnity would be a prerequisite, prescribed in the Convention, to the granting of the permission which applicant seeks. If it is concluded that there would be injury, it is respectfully urged that there could be no justification for omitting to require applicant to make suitable and adequate provision for indemnity before permission is granted to operate the dam in such manner as to cause injury in the United States.

If the pressure on the dikes would be less in flood stages of the river, with the outlet of the lake enlarged, than it is at present, this benefit could not be set off against any injury which might be caused by storage; if overtopping of dikes were averted in an occasional year this benefit could not be set off against injury; if seepage to the drainage districts from the river in flood stages would be reduced, this benefit could not be set off against injury; if the water table were raised in lands which would be benefited by a higher water table, this benefit could not be set off against injury.

If the benefits were deemed to exceed or to equal the injury and the benefits were set off against the injury, the provision for indemnity which the Convention requires would not be made.

If one district were found to be injured and another district were found to be benefited and the benefit were set off against the injury, provision for "indemnity of all interests" which the Convention requires would not be made.

If land in one district were deemed to be injured and other land in the same district were deemed to be benefited and the benefit were set off against the injury, provision for "indemnity of all interests" which the Convention requires would not be made.

The rule stated in the Convention requires that provision shall be made for indemnification of all interests that are injured on the other side of the boundary and admits of no exception. If the land of a particular owner would be injured, provision for indemnity should be made without exception before the injury is done. Omission to make provision for indemnity is not permitted for any reason. If provision for indemnity for injury which would occur to any land were omitted, the requirement of the Convention would not have been met.

It will be observed too that the provision for indemnity is to be approved by the Commission before permission to operate a dam is granted. Obviously the provision for indemnity must be made before the Commission can approve the provision. Provision should be made and approved before permission to operate a dam can be given in accordance with the Convention. The provision for indemnity is to be suitable and adequate. The requirement operates as a safeguard against a situation developing in which injury on one side of the boundary would be caused by a dam on the other side and the injured interests would be without redress. Adequate provision must be made before the injury can be done. If the injury would be irreparable, obviously adequate provision could not be made for indemnity. Irreparable injury cannot be permitted under the next to the last paragraph of Article VIII of the Convention.

The Convention requires that suitable and adequate provision be made and approved by the Commission for indemnity of all interests which may be injured. There are in the Convention no such terms as benefits, net damage, beneficial or detrimental on the whole, the balance of benefit or detriment, or balance of advantage or disadvantage, which are used in Applicant's Brief and in the brief of the Canadian Government.

The requirement that provision shall be made for indemnification of all interests which may be injured is unconditional in the Convention and should be applied without qualification as to benefit or net damage or otherwise.

Whether any benefit would accrue in the United States from the execution of applicant's plans is irrelevant to a consideration of the pending application. Whether more benefit than injury or less benefit than injury would accrue is likewise irrelevant.

4. The statement of the 4th conclusion raises an important question for the Commission to decide. It has previously been emphasised herein that the next to the last paragraph of Article VIII of the Convention of 1909 requires that a decision be made whether injury would be caused on one side of the boundary by the maintenance and operation of a dam on the other side of the boundary. The provision of the Convention cited would require in the present case that a decision be made whether the operation of the dam at Corra Linn would cause injury in the United States. Without such a decision provision for indemnity required by the Convention could not be made.

In conclusion 3 applicant asserts that it has been shown that there would be no injury. In conclusion 4 it is asserted that it has not been shown that there would be injury. Obviously, if conclusion 3 were sustained, it would be useless to consider the 4th conclusion. The position was asserted in answer to conclusion 3 that not only did applicant and the Canadian Government fail to show that there would be no injury, but that the Newell-Jessup evidence shows that a large acreage of land would be seriously injured if storage were permitted. That same position is here maintained with respect to the 4th conclusion.

It has been emphasised that the river provides natural drainage for the lands between the river and the mountains. The storage of water in the river, whether storage would begin in August, September or October, would raise the levels of the river and would decrease the head opportunity and the time opportunity for drainage into the river of lands between the river and the mountains.

The result would inevitably be that throughout the storage season drainage into the river would be less efficient than it would be without storage, the water table in the lands between the river and the mountains would not attain as low a level as it would attain without storage, the water table would be higher throughout the storage period than it would be without storage; and consequently there would be less room in the land to absorb the water when the break-up occurs in the early spring, and the water table at planting time would be higher in the land under storage conditions than it would be without storage. That the water table would be higher during the storage period than it would be without storage is necessarily deduced from the application of natural laws.

The Newell-Jessup studies show that the water table in a large acreage is too high under present conditions to afford the most favourable opportunity for crop growth. This acreage would be benefited by an increase of depth of water table. A slight decrease in depth of water table would render it impossible to cultivate large acreage, would impair the productivity of an additional large acreage and would necessitate excessive pumping in water in additional acreage to prevent injury to crops. The acreages in various districts which had a water table in the spring of 1930, 1931 and 1932 of less than 1 foot; 1 foot to 2 feet; and 2 feet to 3 feet are shown in Newell Exhibit No. 11 at the following pages:—

District No. 1—Page 42.
District No. 3—Page 46.
District No. 4—Page 50.
District No. 5—Page 54.
District No. 6—Page 59.
District No. 7—Page 62.
District No. 8—Page 67.
District No. 10—Page 74.
District No. 11—Page 78.
District No. 12—Page 81.
District No. 13—Page 86.

It will be noted that in District No. 1 there were on May 7, 1930, 100 acres with a water table of 1 foot or less, 420 acres with a water table between 1 foot and 2 feet and 850 acres with a water table between 2 feet and 3 feet; on May 1, 1931, there were 150 acres with a water table of 1 foot or less, 200 acres with a water table between 1 foot and 2 feet and 700 acres with a water table between 2 feet and 3 feet; on May 11, 1932, there were 200 acres with a water table of 1 foot or less, 900 acres with a water table between 1 foot and 2 feet and 750 acres with a water table between 2 feet and 3 feet. A decrease in the depth of the water table of as little as 6 inches would obviously have had a seriously detrimental effect on a large acreage of land in District No. 1 in 1930, 1931 and 1932.

Examination of the corresponding figures for other districts shows that large injury would have occurred from a decrease in the depth of the water table of as little as 6 inches. It would reasonably be expected, and Table No. 1, page 9, Newell Exhibit No. 11, shows that a decrease in depth of water table of considerably more than 6 inches would have been attributable to storage in District No. 1 and other districts in 1930, 1931, and 1932.

The table at page 9 of Newell Exhibit No. 11 and the tables cited above showing acreages with water table of 3 feet or less in various districts in 1930, 1931 and 1932 are impressive as to the extent of injury to lands which would result from storage.

It is believed that on the showing made the conclusion is inescapable that serious and extensive injury to lands in the United States would be caused by the operation of the dam at Corra Linn in accordance with applicant's plan.

The statements made in the Brief of applicant and in the Brief of the Canadian Government, which have been associated above with conclusion four, deal with exceedingly important features of the pending case.

Those statements are understood in effect to put forward the view that it would be impracticable to determine the extent to which the depth of the water table would be decreased by storage and the extent to which riparian lands would be injured.

It is understood, of course, that applicant contends that there would be no injury to lands in the United States. It is not clear that the Canadian Government fully supports that contention. It is stated in the Brief of the Canadian Government, however, that the question whether there will be detrimental effects upon riparian lands is incapable of definite proof. If it could not be definitely proved whether there would be injury to lands, obviously injury to lands could not be defined with precision.

If it were concluded, contrary to the contention of applicant, that interests in the United States would be injured by storage, the acceptance of the view that it would be impracticable to determine the extent to which the depth of water table would be decreased by storage and the extent to which riparian lands would be injured, would leave the pending application in a most precarious position.

A finding that there would be injury but that the extent of the injury can not be determined would render it impossible to make provision for indemnity of all interests injured as is required by Article VIII of the Convention. If it would be impossible to make provision for indemnity, the permission sought by applicant could not be granted in accordance with Article VIII of the Convention of 1909.

If, therefore, it is found that storage would cause injury in the United States but that the extent of injury cannot be defined, the permission sought by applicant should not be granted, because suitable and adequate provision for indemnity could not be made.

5. As to the fifth conclusion stated in applicant's Brief it may be said that if storage would not cause injury in the United States, as is contended by applicant, there of course would be no occasion to introduce the subject of benefits to power plants on the Columbia in the State of Washington as an inducement to the granting of the permission sought by applicant.

Assuming that the storage would be beneficial to power interests in the State of Washington, it is inconceivable that a benefit to power interests in the State of Washington could be considered for the purposes of these proceedings justification for injuring land in the State of Idaho.

The needs or benefits to power in the State of Washington have no relation to the pending application. The Convention of 1909 prescribes the rule which is to control this case. Power in the State of Washington does not enter the present case under the Convention at any point. The paramount question in the present case is, Would storage cause injury in the State of Idaho? The paramount requirement is that suitable and adequate provision for indemnity for all interests which would be injured by storage should be made by applicant and approved by the Commission before the permission sought by applicant is granted. Benefits from storage in the State of Washington have no bearing on the question whether storage would cause injury in the State of Idaho. The suggestion that power interests in the State of Washington would be benefited by storage is wholly irrelevant.

6. The sixth conclusion consists of an assertion that storage would not cause damage in the State of Idaho; of the assertion that substantial benefit would accrue to United States interests, and of a prayer that the permission sought by applicant be granted.

It is deemed unnecessary further to discuss the question whether storage would cause damage in the State of Idaho. The benefits which would accrue to United States interests have been adequately discussed. Whether benefit would or would not accrue to United States interests is wholly irrelevant. It is sufficient to reiterate that the permission sought should not be granted until suitable and adequate provision for indemnity for all interests is made by applicant and approved by the Commission. The implications of this position have been emphasized.

Submission. (1) The proposed storage would destroy the usefulness of a large area of land in various drainage districts in the State of Idaho; would impair the usefulness of an additional large acreage; and would render more difficult and costly the cultivation of land. An indication of the extent of injury will be found in Jessup's Exhibit No. 2, pages 65 to 74.

(2) The extent of injury should be determined before permission is granted to operate the dam at Corra Linn.

(3) Suitable and adequate provision for indemnity of all interests which would be injured should be required before the permission sought by applicant is granted.

(4) Provision for indemnity should be approved by the Commission before the desired permission is granted.

(5) Until the extent of injury is defined and suitable and adequate provision for indemnity of all interests is made and approved by the Commission the permission sought should not be granted.

(6) The cost of any additional investigation desired by the Commission should be defrayed by applicant.

Brief of

The State of Idaho and of the Drainage Districts, Nos. 1 to 4, both numbers inclusive, and Nos. 6 to 13, both numbers inclusive, of the County of Boundary, in the State of Idaho, and the owners of land within said respective Drainage Districts, and Reply to Brief of The West Kootenay Power and Light Company, Limited, and Reply to Brief of the Government of Canada

To the Honorable, The International Joint Commission, Washington, D.C., and Ottawa, Canada.

STATEMENT OF CASE

In September, 1929, the West Kootenay Power and Light Company, Limited, hereinafter referred to as the Applicant, filed with this Honorable Commission its application for permission to construct and operate certain permanent works in and adjacent to the channel of the Kootenai river for storage purposes at Granite, B.C.

The necessity for said construction and operations being set forth in paragraph 15 of the application, as follows to-wit:—

"That the Consolidated Mining and Smelting Company of Canada, Limited, operating large smelters, zinc plants and refineries at the city of Trail, in the province of British Columbia, being dependent upon the com-

pany for an adequate supply of power and having committed itself to your Honourable Commission in connection with another international problem, to erect large, extensive and costly plants in order to utilize the gases which it is at present emitting from its smelter stacks and which it is claimed are causing a nuisance in the State of Washington, U.S.A., and having represented to the company that it will require a large additional supply of electric power within a very short time in order to operate said plants, the company finds it necessary to obtain this power at as early a date as possible and has no means at its disposal to provide such power, within the time when it will be required by said company, other than through the storage project above set forth."

A public hearing on this application was held at Bonners Ferry, Idaho, on November 6, 1929, which hearing was adjourned for the purpose of obtaining additional data in connection therewith.

While said application was pending before this Commission, and before any order of the Commission, in accordance with the prayer of the application, had been made or entered, the applicant constructed a dam on the Kootenai river at Corra Linn, B.C., at a point about six miles below Granite, where the company had originally petitioned for permission to construct a dam.

Thereafter, said applicant closed the sluice gates of said dam and raised the water in the Kootenai river in Idaho in the United States of America at the international boundary line and south therefrom, more than two feet above the normal and natural low-water level.

That in the month of January, 1932, the State of Idaho and the Drainage Districts of Boundary County, Idaho, filed their Supplemental Response to the Original Application of the West Kootenay Power and Light Company, Limited, protesting against the violation by applicant of the treaties between the United States and Great Britain relating to boundary waters.

Thereafter, in February, 1932, the applicant filed its reply in which it admitted the construction of the dam at Corra Linn and alleged that the dam was constructed by the applicant purely and solely as a power dam and that the construction of said dam would not come within ambit of the aforementioned treaty; admitted that they had raised the level of the water in the Kootenai river, but stated that the same was done "inadvertently."

Thereafter the applicant filed an amended application to use the dam, which it had previously alleged was created for power purposes only, for storage purposes and asked permission of this Commission to allow said dam to be used for said purpose and that they might raise the water of the Kootenai river in the United States.

The necessity for said construction being set forth in paragraph 9 of the Amended Application, as follows, to wit:—

"The Consolidated Mining and Smelting Company of Canada, Limited, the chief power customer of the company, had undertaken to the International Joint Commission in certain proceedings then before the said Commission, to construct extensive sulphuric acid and fertilizer plants at Trail, B.C., to utilize the sulphur gases coming from its smelter, and by so doing to relieve the situation that had arisen in consequence of its said gases drifting over the international boundary line and resulting in claims of damage being made by residents of the State of Washington, the said undertaking being to the effect that said plants would be in operation by August or September of the year 1931, and in the operation of which plants a very large amount of electric power would be required, which said power

was not then available and could not be made available unless the power company could increase its production of electric power either through the said storage of water on Kootenay lake, *or through the erection of another power plant to supply the additional power during the winter of 1931-1932 and thereafter.*" (Italics ours.)

To this amended application, the State of Idaho, and the drainage districts above mentioned filed their response and upon issues joined therein a hearing was held upon said amended application at Nelson, B.C.

ARGUMENT

In the consideration of the questions presented to this Honorable Commission, there are three vital elements which are: First, the *necessity* from which arises the construction of power plants; second, will there be any material benefits accruing to respondents by such storage; third, will the respondents be damaged and is said damage compensatable?

The attention of the Honorable Commission is particularly called to paragraph 15 of the Original Application of West Kootenay Power and Light Company, Limited, in which the only reason for the construction given is the necessity to furnish power to operate plants to utilize the gases claimed to be causing a nuisance in the State of Washington.

This application was filed in 1929.

In 1932 the Amended Application of the West Kootenay Power and Light Company, Limited, in paragraph 9, gives the only reason for the construction of the plant at Corra Linn the furnishing of power for the operation of extensive sulphuric acid and fertilizer plants at Trail, B.C.

These plants are, and have been, in operation since 1931 and no necessity has yet been shown in any of the evidence of applicant for any additional power and no necessity has been shown requiring the use of the dam at Corra Linn for storage purposes in order to develop excess power.

In connection with this, this Honorable Commission is particularly referred to the last few lines of paragraph 9 of the Amended Application of the West Kootenay Power and Light Company, Limited, which are as follows:—

> " . . . which said power was not then available and could not be made available unless the power company could increase its production of electric power either through the said storage of water on Kootenay lake, or through the erection of another power plant to supply the additional power during the winter of 1931-1932 and thereafter."

This statement constitutes a direct admission that the power company had other available points for the development of power, the construction and operation of which would have no affect whatsoever upon the land of the respondents herein.

In this connection the attention of the Honorable Commission is directly called to the inspection made by the Commission, and by counsel of various parties, of the plant at Corra Linn on the second day of the Nelson hearing and to the statement of Mr. Lorne Campbell, General Manager of applicant, that applicant had one more site down the river and as soon as a plant was constructed at that point they would have utilized all of the available power on the Kootenai river.

For what purpose does applicant desire all of this power? The only reason given by applicant is the necessity to furnish power to operate sulphuric acid and fertilizer plants at Trail, B.C., which plants are already in operation.

If applicant has any other use for this power, why does it conceal that use from this Commission?

We frankly feel that the attitude of applicant towards the development of its projects has been decidedly unfair, and we feel that the applicant has acted in connection with the construction of the plant at Corra Linn in absolute "disregard" and in flagrant violation of the treaty existing between the United States and Canada and with absolute disregard of the moral obligations due and owing to the Honorable, the International Joint Commission and the respondents herein.

And again we state that the applicant has not presented one iota of evidence showing the necessity for the development of additional power at its plants and has confined itself to statements of counsel that the only necessity for said power is for the operation of fertilizer plants at Trail, B.C.

There is not a single iota of evidence as to the amount of power required to operate these plants.

Applicant has apparently gone upon the theory that if it would construct a plant costing several million dollars, the halo surrounding said expense would be sufficient to cast into the discard any consideration of the rights of individuals or communities which might be ruined by the operation of the extensive works constructed.

We respectfully submit that the lands of respondents constitute more than 80 per cent of the agricultural lands of Boundary county, Idaho, and the entire population of said county is dependent upon the production from these lands and that an injury and loss of these large agricultural lands will not be a damage to the owners of those lands only, but will constitute a damage which will wipe out an entire community, which damage it is impossible to ascertain.

REPLY TO BRIEF OF APPLICANT

The honorable solicitor for applicant, in his excellent brief, has endeavoured to convince the Honorable Commission that the benefits which will accrue to the respondents by the granting of permission to raise the level of the Kootenai river will more than offset the damages which would be incurred by respondents. While we appreciate the big-hearted desire of the applicant to make our lives more worth living, we nevertheless, contend that the Brief of Applicant seems to be entirely based upon an attempt to discredit the evidence submitted by witnesses of the respondents, which witnesses appeared in person before this Honorable Commission and submitted themselves to cross-examination, whereas it seemed to be practically impossible for the rich and powerful applicant to obtain the attendance of any witnesses who dared submit themselves to cross-examination by respondents.

At Page 5 of Applicant's Brief is found the following language:—

> "It may be pointed out in passing that it was necessary to construct the dam to its present height and to provide control features as at present constructed to insure the proper operation of the power undertaking throughout all seasons of flow, quite irrespective of its possible future use as a storage dam."

We concede the truth of this statement and again respectfully submit that said dam was built for the ulterior purposes of applicant and not for the purpose of furnishing to, or conferring upon, the respondents any benefits whatsoever.

At page 10 of Applicant's Brief, is found the following language:—

> "It is further agreed that if Grohman narrows is improved as proposed by the excavation of 250,000 cubic yards, the discharge capacity

of the dam is sufficient, if properly regulated and controlled, to permit the drawing down of the water levels of Kootenay lake and in the river reaches extending upstream to Bonners Ferry, to an elevation well below the elevations which would obtain under natural conditions."

Of what benefit this would be to respondents, we are unable to determine.

The attention of the Honorable Commission is respectfully called to the testimony of all of the farmers who appeared before this Commission to the effect that the normal low water state of the Kootenai river was the most beneficial stage for farming operations and that as the water was drawn out much below the average low water, the land became too dry for successful farming operations.

At page 46 of Applicant's Brief occurs the following language:—

> "This act of holding water in the drainage ditches and within the so-called critical areas must of necessity raise the water table within these adjacent areas."

This statement is based upon the Exhibit of Mr. Fred Mathews (page 60 of Exhibit 4) that the sluice gate of District No. 7 was kept closed during the winter of 1930-1931 and the same exhibit shows other inaccurate statements by the same party.

Although Mr. Mathews was present in Nelson at the time of the hearing before this Honorable Commission, his exhibit was offered by another party who had not prepared the exhibit and Mr. Mathews did not take the stand as a witness for applicant and respondents had no opportunity to cross-examine Mr. Mathews on his exhibit.

We refer to the statement of Mr. Mathews on page 33 of Applicant's Exhibit No. 4 in which Mr. Mathews states that "District No. 4 contains an unusually large amount of peat soil and Mr. Des Voigne and Mr. Kuper realize that the water table must be kept very high."

Where Mr. Mathews obtained this information is not known as the evidence of Mr. Des Voigne at Transcript pages 323-328 is directly contradictory to Mr. Mathews' statement.

Also, at page 51 of Applicant's Exhibit 4 Mr. Mathews states, referring to Drainage District No. 6: "The farmers of this district realize that it is necessary to maintain a high water table and therefore allow the water to accumulate in the drains as much as possible."

This statement is contradicted directly by the evidence of Mr. Gieszelmann, Transcript, pages 321-323.

It is also exceedingly strange that the majority of the farmers from the Kootenai Valley who testified at the hearing at Nelson, all of whom were commissioners in their respective districts, were not acquainted with and did not even know Mr. Mathews by sight.

The attention of the Honorable Commission at this point is specifically called to the testimony of Mr. J. J. Whitten, a commissioner of Drainage District No. 7, at page 315 of the transcript in which Mr. Whitten specifically states that the sluice gate in District No. 7 was not closed in the winter of 1930-1931, or at any other time, and that in District No. 7 they never attempted to irrigate the lands in said district by backing up the water into its drain ditches.

To the same effect is the testimony of Mr. Geo. Irving, at page 329.

In this connection we desire to call the attention of the Honorable Commission to the testimony of all of the farmers who appeared before the Commission at Nelson, representing practically every district and every section of land in the Kootenai Valley and the uniform statements of these practical men that it was impossible and impractical to irrigate by the use of drain ditches.

This testimony is found as follows:—

J. J. Whitten, Transcript, page 315.
E. J. East, Transcript, pages 319-320.
Theodore Gieszelmann, Transcript, page 322.
E. Des Voigne, Transcript, page 324.
Geo. Irving, Transcript, page 329.
Geo. C. Crocker, Transcript, page 332.
Simon McDonald, Transcript, pages 340-341.
Oliver H. Campbell, Transcript, pages 354-355.

We respectfully submit that the evidence of men engaged in actually farming the land is the best evidence obtainable and the most reliable, being based upon fact and not upon theory.

Again referring to the lofty motives of applicant and its desire to benefit the respondents so materially, we call attention directly to what this supposed benefit is to be.

It is really, according to the applicant, the taking off of the peak of the high water so that the dikes of respondents would be able to withstand these terrific catastrophes which occur once in every 20 years.

We had one of these catastrophes in the year 1933 and we respectfully refer the Commission to the testimony of Mr. Matheson, a witness for the applicant, which appears at pages 126-128 of the transcript, wherein Mr. Matheson testified with reference to the date of the breaking of the dike system in 1933; that if the excavation contemplated by applicant had been completed the lowering of the water level at Bonners Ferry on June 20, the date of the flood peak, would have been 0·89, but that he could not say this lowering would have saved the district from flooding; and in reply to the question as to whether or not the flood was caused by water topping the dikes, replied:—

> " sometimes when the water rises, if the level is maintained for a considerable time and the soil under water gets water-logged, it has a tendency to slump out. At other times it may be a case of the water seeping through the earth, water-logging on the other side, and slumping out the dikes on that side."

Mr. Matheson further testified that he did not have the necessary information of his own knowledge as to which of these conditions existed in the drainage districts, all of which testimony we respectfully submit is sufficient answer to the claims of applicant of the enormous benefits which will be derived by respondents; but we again respectfully refer the Commission to the evidence of the practical farmers referred to above, all of whom have lived for a number of years in the drainage districts, and have been unanimous in their testimony that the danger to the districts does not arise necessarily from flood and overtopping of the dikes, that protection from high water may be maintained by the districts, and that interference with low water level of the river during the winter time would interfere with the proper drainage of their lands, all of which testimony is fully confirmed by the investigations and reports of the Idaho Department of Reclamation, the United States Geological Survey, and of the United States Department of Agriculture.

It is difficult to understand how anyone could read the report submitted by Mr. McGee and make the broad statements concerning the same as are contained in the Brief of Applicant beginning on page 89.

It is quite evident from the study of this report that the statements contained therein refer to the average elevations to be maintained by the West

Kootenay Power and Light Company. The averages shown on the graphs and detailed in the tabulations set forth in this report show that counsel's statement at the beginning of his answer to this report is wholly without foundation.

On page 90, paragraph 2, Applicant's Brief states that "The additional level of the river under storage will not be within 17 to 24 feet of reaching even the bottom of the dike, . . ." while as a matter of fact there are 17 places within the diked area where the dikes extend to a point where even 4 feet of water would cover the base of all of these dikes and should the application be approved, the base of all of these dikes would be under water at all times during the year, resulting in a saturation such as will leave them unstable and more subject to rupture during the high water period.

On page 91 Applicant's Brief states: "The objection already discussed by me here again applies, namely, that the water in the drain ditches in and adjacent to the critical areas, called by Mr. McGee the 'wet areas,' was during the greater part of the investigation kept at an elevation higher than the proposed storage level."

Just what investigation showed this condition, or just what measurement of wells, or other information, did determine such a conclusion is not stated, and the McGee report is fully confirmed by the evidence of the farmers hereinbefore referred to.

The facts are that the greater portion of all the drain ditches in the entire valley is dry during the growing season—that is, from May to August—this being due to the water having drained out of the land and into the Kootenai river through the natural underground channels and all of the well measurements taken for the past three years prove this to be a fact.

As to the three erroneous assumptions beginning on page 91 of Applicant's Brief, we will take them up as they appear therein. Firstly, there is no statement, either in Mr. McGee's report or in the graphs or exhibits shown therein, that would lead anyone to believe that he shows a higher water table from April 1 to September 1.

Secondly, it is quite apparent from the study of the well measurements taken by the United States Geological Survey that the flow of the water in the underground channels has a gradually decreasing subsidence as it nears the elevation of the water in the river, and if this river outlet is obstructed by an increase in elevation, it will reflect throughout the area, just as it is reflected under the natural conditions; and as the underground water recedes under the natural conditions to a certain particular point and the outlet to which this water drains is obstructed in any amount, a like increase in underground water can reasonably be expected throughout the entire area. The soils of the various drainage districts being similar in character, time and gradient are the two elements that determine the depth to which the water will drain.

It is proposed by the West Kootenay Power and Light Company that they reduce the gradient and decrease the time, and the effect of such action is clearly shown on the graphs after having taken into consideration all of the wells in the district for the period of time record has been taken.

Thirdly, the well records show that the low period of water is at, or about, February 1 of each year when the thaws bring on a decided recharge. At this time of the year the greatest underground reservoir is required, and in case the underground reservoir is charged by the retarding of the natural drainage so that the spring recharge has no underground area to fill, then the water will remain at, or near, the surface of the ground during the spring planting season.

It is at this time of the year when drainage of underground channels is absolutely necessary. It makes no difference what the drainage is in September or August if the ground is allowed to be wet and remain wet during the planting season of April, May, and early in June, and this is the period of time covered by Mr. McGee's report.

On page 92, the second paragraph, Applicant's Brief states: "One look at Mr. McGee's graph of District 1, as an example, next to page 29, of the exhibit, shows how wrong his method is."

It is quite apparent from the statement following this introduction that one look is all the applicant took. The lines selected as shown on the graphs and the wells located thereon are affected from surrounding territory and not only by that covered by the line so that all of the wells in the district were averaged and taken into consideration and the results of that consideration are shown on the line.

As a consequence, it is quite apparent that in an undulating country, some outside influence not shown on a line would tend to increase or decrease the elevation of the water at that point.

If applicant had made a careful study, taken into consideration all of the wells, then, and in that event, it certainly would not have made the statement that it does make.

That the flow of water from the hill to the river is a fact is proven by all of the engineers who have made investigation of these projects. Mr. Mathews, in his report, page No. 4, even goes so far as to say that the data shows distinctly that the main source of water in the lands of the Kootenai Valley since the dikes were built is the seepage from the surrounding mountains and the natural precipitation.

The river, being the master drain for all of the districts during the long winter season, un-waters the bottom lands to the extent that a sufficient reservoir is created to adequately accommodate the water furnished by the spring break-up. It is proven, by all of the engineers who have made an investigation, that should this reservoir be curtailed by a lack of proper drainage during the winter months, that the spring break-up would furnish a sufficient amount of water to raise the water table too close to the surface of the land for early spring planting, and, as a consequence, no crops could be grown, regardless of the condition of the soil, as to water table, later in the growing season.

Applicant takes as an example, page 92 of its brief, District No. 1. The statement concerning the undulating character of the water table as portrayed is fully confirmed by Mr. Mathews on page 10 of his report wherein he says:—

> "A very peculiar condition exists on the east side of the district south of the Spokane International Railway tracks; directly north of the tracks at an elevation of 1760 is a small lake which must have a higher underground source, as it is full before the high water period."

Mr. Mathews goes on to detail other peculiar features of this drainage district proving beyond question that the lines as shown in the McGee report are correct.

Another place in Mr. Mathews' report, page 52, Mr. Mathews discusses another peculiar situation. He states:—

> "All the wells, except those near the river, gradually lowered from early spring until January, 1931, and showed very little effect of either the high water of the river or the seepage from the high water in the drain ditches. In fact, from June during the rest of the year the water in the wells near the drain ditches, and those away from drains or river, was lower than the water in the drain ditches, showing that the drain ditches are used rather to distribute and irrigate the land than to drain it."

Here is a peculiar situation. Drain ditches forming a network over Drainage District No. 6 showing a distribution of water with absolutely no source of supply. It is a most peculiar thing how water can get in the drain ditches and distribute out through the land when they have neither a source of supply from the foothills nor the river.

As a matter of fact, no well record taken will show such a condition. The facts are that during the periods of high water the seepage from the river into and under the lands of the drainage district and the seepage from the hills to the same lands form troughs and, until the river has receded to a point where the land can drain into the river, the water planes are more or less undulating until practically the low water in the river, when they are on a comparatively even grade.

He states further on page 53:—

"During the entire fall and winter of 1931 all the wells were lower than the river or drain ditches and lower than in the fall and winter of 1930, even though the river was higher in the fall and winter of 1931 than in 1930, showing the river had little effect on the water table in the land."

As a matter of fact, all of the wells close to the river show a higher elevation than the river itself. The drainage slope, however, being directed towards the interior lands and if the elevation of the water in the river is increased to the point sought by the applicant, then a distinct increase in seepage from the river during the low water period may be expected.

These examples are characteristic of the entire Mathews report. The inaccurate statements in said report are so glaring that no further comment will be made regarding them.

In conclusion, it is a most remarkable thing that Mr. McGee confirms the contention of applicant regarding the use of a drainage system for irrigation. No statement in Mr. McGee's report could possibly be construed as advocating the use of a drainage system for irrigation purposes, but it is clearly stated that a drainage system must, if properly designed, serve two purposes: (Idaho Exhibit 1, page 3).

First, to properly unwater the land during the period of time when planting of crops is in progress and also be so designed that it will not have a tendency to overdrain the land to the injury of growing plants, and McGee further states on page 31 of his report: "These conditions have been studied and considered by all of the districts and their drainage systems have been designed and constructed to meet these requirements."

Altogether, applicant's analysis of the McGee report shows an utter lack of the understanding of the drainage problems and particularly those affecting the Kootenai river.

REPLY TO BRIEF OF CANADIAN GOVERNMENT

In the brief filed on behalf of the Government of Canada in the discussion of the issues involved it is recited that there is no difference of opinion in any quarter in respect to the resultant effects from the applicant's proposals, and that the only point of difference is with reference to the question of damages to the drainage districts; that is whether or not the storage of water in Kootenay lake during the months of September, October, November, December, January, February and March, and the resultant raising of the low water level in the Kootenay river adjacent to the drainage districts during that period of time will result in damage to the drainage district lands by reason of detrimentally affecting crop production.

The Canadian Government engineers, from their studies and investigation of ground water conditions in the drainage area, conclude that the maintenance of a higher water level during the storage season as contemplated by the applicant will not injuriously affect the agricultural value of the drainage district lands, and it is the applicant's contention that the benefits to the drainage area from flood control will more than offset any detrimental effects from the higher levels proposed in the fall and winter months.

On the other hand the engineers of the United States Government and of the State of Idaho, from their study of the ground water in relation to river

levels, concluded that the raising of the low water levels of the river during the storage season of applicant would result in raising the ground water table and would have an injurious effect upon crop production.

We respectfully call the Honorable Commission's attention to paragraph (20) of the amended application as follows:—

> "The company respectfully submits that the said works completed and proposed and the method of operation of the dam as proposed by the company will not have any injurious effect on any interests in the United States or any state thereof. Furthermore, the said proposed works and the operation of the said dam in the above mentioned manner will make it possible to decrease the high water levels at the International Boundary line and beyond it, to the benefit of all interests in the United States and particularly to all interests in the State of Idaho, and is a benefit now being sought by said interests."

It is our position, therefore, that if it is substantially proven that damage would actually result from said proposed works this Honorable Commission should deny its approval of said proposed works.

Attention is called to the opening statement of Mr. Crowe at the hearing wherein it was stated that while some few of the drainage districts would be adversely affected by the storage proposed the negligible injury would be offset by the high water control. The evidence and report of Mr. McGee of the Idaho Department of Reclamation, that of Mr. Newell of the United States Geological Survey, and of Mr. Jessup of the United States Department of Agriculture, together with the evidence and testimony of the several residents of the various districts, confirms and supports every allegation of respondent as to the damage that will result from the proposed storage, all of which evidence, reports and testimony is fully before this Honorable Commission, precluding the necessity for further review or analysis thereof. Sufficient to call the Commission's attention to the emphatic statements of the representative witnesses from the drainage area that their chief concern is not with the flood problem, a problem which they are well able to care for within their respective districts, but rather with the inestimable damage to their lands by interference with their drainage by reason of the maintenance of the river at a higher level during the normal draining period, which interference would prevent the proper drainage of said lands, cause them to become wet and water-logged and valueless for crop production. It should be obvious to the Commission that the flood control advantages of the proposed works, making possible the lowering of the flood peak at Bonners Ferry of less than one foot in such years as during the high water of 1933, would be of little effect in protecting the dikes, which at low water season are 15 feet or more above the water level of the river, and the concern of the landowners of the drainage area is readily understood when such slight flood control benefit is compared with the detrimental effect of even the slightest interference with the proper drainage of the lands during the low water season.

We respectfully submit, therefore, that any benefit resulting to the drainage area from high water and flood control by applicant's works would not be sufficient to compensate for damage to the agriculture lands by reason of interference with their proper drainage during the low water season, that applicant has not shown the necessity for the storage proposals and the resultant injurious effect to respondent drainage district lands; that the damage to respondents would be irreparable and not compensatable, and, therefore, the application should be denied.

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Summary of Reply of West Kootenay Power and Light Company Limited to the Brief for the Government of the United States Dated March 5, 1934

Interpretation of the Treaty. The United States Brief brings up two points concerning the interpretation of the Convention of 1909 which require an answer:—

In the first place, the said Brief states that the construction, maintenance and operation of the dam at Corra Linn are within the jurisdiction of the Commission as conferred by Article VIII. With this statement the applicant takes issue. The construction, maintenance and operation of said dam solely as a power dam as distinguished from a storage dam is wholly Canadian in purpose and effect and while being so operated it will not "raise the natural level of water on the United States side of the boundary line." Therefore no jurisdiction is given to the Commission to grant or refuse to grant permission to so operate. Only when it is used as a storage dam and, as a consequence, raises the natural level of the water on the United States side of the boundary line is jurisdiction given to this Commission.

The second point raised in said Brief is that the Commission is not to consider whether there is a balance of benefit over injury, or the reverse. The applicant states that the Convention clearly indicates that both injury and benefit are to be considered, and only the excess of injury over benefit to be paid for in money as ordered by the Commission or in some other compensatory work to provide additional benefit to offset such injury.

In the present case, each and every district and each and every owner therein that alleges injury will ensue will receive the benefit from the lowered water levels during the flood periods; therefore a balance could be struck. As further proof that the Convention anticipated allowing the Commission to weigh benefit against injury and provide for it by money or compensatory works, the applicant refers to the following paragraph of Article VIII of said Convention:—

> "The Commission in its discretion may make its approval in any case conditional upon the construction of remedial or protective works to compensate so far as possible for the particular use or diversion proposed, and in such cases may require that suitable and adequate provision, approved by the Commission, be made for the protection and indemnity against injury of any interests on either side of the boundary."

This paragraph clearly indicates that the Commission, were it of the opinion that some injury would occur, could order compensatory works to give benefits to balance said injury. In the present case, the applicant has come forward proposing the remedial and compensatory work that will confer upon the districts substantial benefits:—

Extent of Lowering Flood Levels. This subject is dealt with on pages 8 to 12 of the United States Brief. On page 9 of said Brief it is admitted that lowerings of as much as 4 feet might be realized under the most favourable conditions, but that by confining the investigations to the levels of the river that prevailed since 1928 as was done by the United States engineers, the lowering would have been from 2 feet at the boundary line to 1·1 feet at Bonners Ferry.

The Applicant has computed that it would lower Kootenay river as much as 4·56 feet for a flow of 200,000 cubic feet per second. The United States Brief at page 11 states that the applicant's figures show a lowering of only 2·11 feet because, the Brief states, the applicant used a higher lake elevation for an out-

flow of 200,000 c.f.s. under original conditions than is acceptable to the governmental agencies, and the Brief proceeds to adjust the result by the simple but entirely erroneous method of reducing it by the amount of difference between the original elevation of the lake for 200,000 c.f.s. outflow as given by the curve used by the two governmental agencies and that used by the applicant. Since the curve for proposed conditions is based upon the curve adopted for original conditions, any error in the original curve wil be reflected relatively in the deducted curve. Therefore the United States Brief, in lowering the applicant's lake elevation for original conditions for 200,000 c.f.s. should also lower relatively the applicant's deducted elevation for the proposed conditions.

The applicant therefore resubmits that the adjusted improvement in lake level, based on the applicant's computations and the governmental discharge curve for original conditions, will still be in the neighbourhood of 4·6 feet and not in the neighbourhood of 2·11 feet as is claimed in the United States Brief.

The applicant desires here to register with the Commission strong exception to the suggestion on page 11 of the United States Brief that the figures of the United States engineers as to the extent of lowering to be effected are more trustworthy or better established than those of the engineers of the Canadian Government or of the applicant. The Canadian Government engineers' computations have been made on a most conservative basis for, as shown in detail on pages 41 to 43 of Canadian Government Exhibit No. 1, they have been most conservative in determining upon coefficients to apply on the hydraulic formulæ used and likewise in giving weight to the basic data upon which the studies are founded, and to the interpretation of many factors entering into the problem.

It is therefore resubmitted that the lowering to be effected during high water as set forth in the computed figures of the Canadian Government engineers should be considered as being more conservative than will actually be realized.

Beneficial Results to Idaho from Flood Relief. On pages 12 to 15, the United States Brief discusses the beneficial results to Idaho from flood relief as a result of the applicant's excavation proposals. The Brief on page 13 upholds Mr. Davenport's estimates that the lowering of flood stages resulting from the applicant's works would materially reduce the loss and damage in Idaho once in 20 years and does not consider that this is an underestimate of the benefits accruing from the enlargement operations at the lake outlet.

In this connection also the Brief at page 13 takes exception to the suggestion made at page 22 of the Applicant's Brief that had Mr. Davenport considered the 1933 flood as being capable of flooding 28 per cent of the total reclaimed acreage in Idaho, which it did, he would have included the floods of 1921, 1927, 1928 and 1933 with those of 1894, 1916, 1903 and 1913 as capable of doing serious damage; and also that if Mr. Davenport had considered the effects of the 1933 flood, he probably would have found that a reduction in the flood level of 1 to 2 feet as estimated by him would have meant the difference between serious loss and small loss in four out of the last seventeen years instead of one out of twenty years.

The United States Brief states that since conditions in 1921, 1927 and 1928 are known it is not apparent why conditions in 1933 should be used as a basis to estimate what might have occurred in those years. It is submitted that the conditions in 1933 do serve as a criterion of what might have been expected in 1921, 1927 and 1928 for the reason that the floods of 1921, 1927 and 1928 as well as those of 1898, 1899, 1908, 1909, 1919 and 1925 mentioned on page 61 of the Canadian Government Brief were floods of similar magnitude to that of 1933 and under the same conditions of restricted channel and reduced storage area as that of 1933 would have possibly equalled the peak levels of the 1933 flood. Prior to 1920 there were no drainage district dikes to restrict the flood

waters to the river channel and consequently the river in Idaho at and below Bonners Ferry did not rise as high as it now does under similar floods. Between 1920 and 1928 some nine drainage districts were diked off from the flood plain of the river and since 1928 the river has been further restricted by the construction of dikes around four additional districts.

In this connection it is stated at page 15 of Davenport Exhibit No. 1:—

> "The floods in 1927 and 1928 occurred after much diking along the river in Idaho, and they would have been considerably lower under conditions existing prior to the diking."

This statement could be continued to state that the floods in 1927 and 1928 would have been considerably higher under conditions existing in 1933 due to the further construction of dikes along the river. Likewise all the abovementioned floods would have been considerably higher under the channel conditions of 1933. Moreover, of the five dikes that failed during the 1933 flood four were breached prior to the day on which the flood reached its maximum at Bonners Ferry, indicating that a flood of somewhat lesser proportions would have resulted in very material damage to the drainage districts.

It has also to be remembered that in both 1927 and 1928 with the flood plain considerably less restricted than at the time of the 1933 flood, dikes were breached with resultant damage. Had the thirteen districts been constructed prior to the 1927 and 1928 floods the actual conditions would have been aggravated and the damage would undoubtedly have approached if not equalled that of 1933.

The United States Brief, on page 13, also maintains that none of the damage arising from the 1933 flood was caused by the overtopping of the dikes. In this connection it is desired to reiterate to the Commission that no one has contended that failure of the dikes and damage to districts was solely or even largely the result of the overtopping of the dikes.

In the Canadian Brief, page 58, it is pointed out in connection with the high-water season of 1933, when five districts were flooded, that failure of dikes during high-water periods is not caused only by overtopping of the dikes. It is also caused by the action of a head of water on the river side of the dike, which results in a permeation of water into the body of the dike wherever weaknesses have developed or are latent in its body structure; by the gradual softening and slumping of the dike material by such water permeation; by the washing away and the undermining of the dike by the action of the river current; by the development of sand boils; and by the general weakening of the dike structure; *all of which are the direct result of the head of water imposed upon the dike by high water in the river channel.*

It is again submitted that at all times when the water level in the river is higher than the ground level behind the dikes there is a possibility of failure through sand boils or other forms of dike weakening. Any factor which will tend to lower the high-water level during flood season is a factor of most essential importance to the drainage districts.

The United States Brief, on page 14, then advanced the argument that with the passage of time the dikes will probably be improved so as to be more effective in protection against higher and higher floods. Such an argument carries no weight. Improved dikes cost more money. Higher dikes cost more money and may be practically impossible. The better maintenance of dikes costs more money, and therefore the argument on the point amounts to stating that by the expending of more money in improving and maintaining dykes, the affected districts in Idaho could protect themselves against the floods mentioned, and would need no help from the applicant or any other party in the way of lowering the flood levels.

This argument of the United States Brief is in entire conflict with the opinion of the United States Army Engineers, Canadian Government Exhibit No. 8, where it is stated that "experience with the existing levees indicates that higher levees than those now in use would be unsafe," and "that the best apparent solution for the flood control problem is to reduce the flood heights in Kootenay lake by increasing the outlet capacity combined with a proper and well co-ordinated system of levee." Also Colonel Herbert Deakyne, Senior Member, Corps of Engineers, at page 5 of said exhibit, states: "It is the general opinion that an increase in levee heights is impracticable and that additional protection can be obtained only by the lowering of the flood plane."

This portion of the United States argument, however, cannot be passed over without repeating the admissions therein made that the proposed works of the applicant will effect a lowering of the flood levels in Idaho, and that substantial benefits would therefore ensue to the reclaimed lands under present conditions, and in support of this statement is quoted from pages 14 and 15 the following paragraphs:—

> "It is probable that if the proposed works had been completed and they had been allowed to exert their maximum effect in lowering the river, the damage in 1933 might have been considerably less than it was and one or more of the districts that were flooded might have been saved. In estimating in the future the probable frequency and extent of benefit which would accrue to lands in Idaho from the proposed works, it will of course be necessary to regard the year 1933 as one in which, with dikes such as then existed, substantial benefit would have accrued."

And again on page 15:—

> "That benefits which have not been precisely defined would accrue to lands in Idaho as a result of the lowering of flood levels, is not disputed."

The applicant emphasizes here a very important point which is that when a dike gives way in a district at one spot, the result is the flooding of the entire district, meaning that the owner thereof has not only been prevented from recovering any crop, but has lost the labour and material used in the preparation of the ground, and the seeding thereof; the loss of crop not being confined to the low land in the district or the so-called critical area, but to the whole district. The admission, then, of the United States Brief that benefit will accrue from the flood relief is an admission that benefit will accrue to the whole of each and every district involved.

The argument later put forward on the alleged injury is an argument that only certain parts of certain districts will be injured during the storage season, being those parts constituting the so-called critical areas, when neither the labour nor the cost of preparing the land and seeding it will be lost. The final argument of the United States Brief on this subject is that it is immaterial in any event whether there are any benefits accruing or not, and this argument has been already dealt with.

Earlier Investigations. As set forth in the Applicant's Brief, pages 24 to 30, the evidence establishes the point that several different investigating bodies of engineers of British Columbia, Idaho, the United States Government and private parties not interested at all in power or storage, but with the sole object of ascertaining the most feasible method of reclaiming the Kootenay valley lands in Idaho and British Columbia, came to the conclusion that it could not be done by dikes alone, but by dikes in conjunction with the widening and deepening of the control points below the main lake, and particularly at Grohman narrows, and that such widening and deepening must include a dam in the Kootenay river at or below Grohman in order to maintain the low levels of the lake, in the interests of navigation.

The United States Brief attacks this point by saying the earlier investigators mentioned or had in consideration the removal of much larger quantities of material than that proposed by the applicant. Said Brief does not deny, but fails to mention, the necessity of and value contributed by the applicant in the control dam. It rests its attack upon the statement that the applicant does not propose to remove as much material in its excavation from Grohman as was suggested by the earlier investigators. Its attack, therefore, fails to meet the point.

The applicant has nowhere claimed that it is going to do all the excavation that might be necessary to successfully reclaim the lands in the manner suggested by these earlier investigators. What it claims is that the building of the control dam, the excavation of 1,218,000 cubic yards of material and the building of other compensatory works in the river done or proposed to be done by the applicant at a cost of several million dollars, is all a part of the proposed program for successful reclamation, no part of the cost of which has to be borne by the reclaimed lands. It is a foundation already laid upon which said program could be completed at probably a small portion of the cost originally contemplated by these investigators. It is the performance of a very large portion of the work of reclamation of Kootenay flats as recommended over a period of fifty years by outstanding engineers in the public service of the Government of the United States and of the Government of Canada, the State of Idaho, and the Province of British Columbia, whose unanimous opinion it was that the lowering of Kootenay lake and of the water upstream therefrom during the high water season by means of excavation at the control points in the outlet of the lake is an essential feature to any successful reclamation of the area in question, and that before any substantial amount of enlargement or excavation could be done at said control points, a control dam had to be erected in order to hold the low water levels at a point that would not interfere with navigation.

What the applicant and the Canadian Government desired to call to the attention of this Honourable Commission was that the work already performed or proposed to be performed by the applicant, resulting in the lowering of the levels of the river and lake during the flood period, constituted a cardinal feature of the successful reclamation of the flats, and that the excavation proposals of the applicant and the building of the control dam at Corra Linn constituted by far the greatest part of the construction or cost needed for the realization of this successful reclamation.

United States Army Engineers Report (Canadian Government Exhibit No. 8). The United States Brief takes issue as to the interpretation of the conclusions in the Army Engineers Report and states that paragraph 95, page 29, of said report (Canadian Government Exhibit No. 8) relied upon by the applicant as substantiating its argument, does not have the meaning which the applicant gave to it. Paragraph 95 reads as follows:—

> "The reclaimed areas in Idaho are at present probably subject to the possibilities of greater damage through floods during the summer season than from improper drainage of the sub-soil due to the raising of the water table during the fall and winter months."

The United States Brief takes the position that in making a statement regarding the raising of the water table during the fall and winter months, the Army Engineers were not referring to the possible raising of the water table under the applicant's proposals.

It is respectfully submitted there was no other thought in the minds of the different parties who contributed to this report than the effect on the reclamation districts of both the storage and flood relief proposals of the applicant, and that no other meaning can be given to this conclusion than

that set forth originally by the applicant in its argument at page 29. The position taken by the United States Brief is not justified either by the words of said paragraph nor any other part of the report, or by the history of said report. Investigation by the United States Army Engineers took place after our original application was made to this Commission, and as stated in said report, the said engineers were conversant with the fact that the application was before this Commission. There are many references therein to the application for storage of this applicant, and both the flood relief which the applicant claimed it would give and the effects of the higher storage level during the storage season are discussed, while attached to the United States Army Engineers' Report and forming part of it is a copy of the storage hydrograph as filed by the applicant with its application.

Paragraph 87 of said report commences with the following statement: "Storage in Kootenai lake as proposed might very largely increase the duty of pumping from Districts 1, 6 and 7 during October, November and December if it were found necessary to maintain the low water table in the reclaimed land during these months." There is no storage proposal except that of the applicant discussed in the report, and if there were any other storage proposal or any other agency which was going to raise the water table during the fall and winter months, the United States Brief would call attention to it.

Having made a study of these proposals and an investigation upon the ground, and having as already indicated found that only three districts could possibly be affected by the higher storage levels (and then only under certain conditions which were problematical and to the limiting extent there found and which could be remedied by additional pumping) the said report proceeds in paragraphs 94 and 95 to summarize its conclusions upon the whole project, weighing the benefits against the possibility of injury, as follows:—

> "94. In connection with the dam and compensatory works proposed by the West Kootenay Power and Light Company it seems that the use of storage as proposed is desirable for the highest utilization of the potential power in the Kootenai and in the Columbia, and the compensatory works will be of benefit during flood stages to all overflow lands in the valley above the lake, in Canada as well as in the United States, in that it will increase the discharge capacity of the river.
>
> "95. The reclaimed areas in Idaho are at present probably subject to the possibilities of greater damage from floods during the summer season than from improper drainage of the sub-soil due to raising the water table during the fall and winter months."

Surely these words are definite and convincing as referring to the decrease in flood level caused by the proposed works of the applicant and the increase in storage levels by the same works, and amount to a conclusion that the works are desirable both in the interest of Idaho and British Columbia, and justify the applicant's statement that the Army Engineers, after an investigation the report of which was submitted and made a document of record of the United States Congress, concluded that the benefit of the works so far outweighed any possible chance of injury that the works were desirable to the reclaimed districts.

Raised River Levels During Storage. It is of importance in considering the results of the United States and Canadian Government computations of the amount river levels will be raised during the storage period, to remember that the United States computations are based upon the extreme application of the storage proposals at all times; that is, the holding of the lake at the maximum storage level at all times, regardless of the draw-down to meet power-house needs, while the Canadian computations have been based upon the variation in storage levels under actual power plant operation.

In other words, while the application for storage by the applicant, of which Drawing No. F-239 was a part, shows both an upper and a lower limit for storage level throughout the low water period, the United States computations take into consideration only the higher limit and they have therefore found that the back water effect in Idaho will be greater than it would be under average conditions. The applicant realized from the average low water flow during the storage period into Kootenay lake that it would not be able every year to maintain the level at the higher storage line and continue regularly to draw off 9,300 second feet for power purposes. By not taking this fact into consideration the United States computations shows the extreme effect of storage that could possibly take place, and not the average.

Effect of Increased Levels During Storage Period. The Applicant's Brief, pages 33 and 34, calls attention to what is an admitted fact, that the lands near the river and behind the dikes, called the " levee " areas, and the adjoining lands called the " other " areas are the highest lands of the districts, and the low lands, called by the United States investigators " critical " areas, are in all cases farther from the river than either the " levee " areas or the " other " areas, and usually are adjacent to the foothills. Invariably in all districts these " levee " and " other " areas are of a substantial width and the Applicant therefore argued that this strip of high land with such an ample margin between the level of the high storage line and the level of the surface of the ground would be an absolute impediment to the seepage of water from the river to the lower lands beyond this strip. Seepage into these high lands, but not through them to the low lands, would be immaterial in the issue of alleged injury to low lands.

The United States Brief, pages 22 to 27, takes issue with this argument and refers to different statements in the evidence and Applicant's Brief to prove that there is seepage from the river to the low lands. It is quite apparent, however, from the reference that there is confusion in the United States Brief between seepage at the storage levels, and seepage at the flood levels, and the applicant's argument is limited to the statement concerning the impossibility of there being seepage as a consequence of the elevated storage levels.

In support of the applicant's argument and in answer to the United States Brief's contention against such argument, the applicant now submits that the well study of the water tables for the districts, carried on for almost three years by the United States Geological Survey engineers, as shown by the data introduced by Mr. Newell in evidence (which data was used in Canadian Government Exhibit No. 10), shows that for the greater part of the storage period in all the years investigated, it was physically impossible for there to be any seepage from the so-called " critical " area to the river and likewise impossible for there to be any seepage from the river to the so-called " critical " area because between the river and the " critical " area the water table in the " levee " or " other " area was higher than either the river level or the " critical " area water table level. So that if there were seepage during such time it would have to be first proven that water would flow uphill.

This situation is graphically shown in Canadian Government Exhibit No. 10, where the hydrographs show that for a very large part of the storage period during the years under investigation, the water table in the " levee " or " other " areas was higher than the water table in the lower " critical " area or the level of the river.

District No. 1. Since conditions during a substantial part of the storage period were similar in all districts, only Districts 1, 4 and 7 were considered particularly. From a detailed study of these districts it is apparent that owing to the height of the water table in the " levee " and " other " areas, water would have had to flow uphill to pass from the " critical " area to the river, or from

the river to the "critical" area. For the shorter periods when such physical obstacles did not prevail, there would still be what the applicant has called a strip of high land of sufficient width to prevent during such short periods of time when seepage might be possible into the high land, increased levels of the river during the storage period affecting in the slightest degree the level of the water table in the low areas. The United States Brief seems to assume that the applicant would have to show that the intervening high land was impermeable to support such an argument; whereas it only has to be sufficiently so that in the short period available sufficient water could not seep to raise the level at a great distance from the river.

That there was actually no relation between the levels of the river and the water table in the low or so-called "critical" areas is very definitely shown by the data introduced by Mr. Newell obtained from two and a half years' study of water table conditions, which data were available to the applicant and to the Canadian Government, and are interpreted by Messrs. V. Meek and S. G. Dawson of the Dominion Water Power and Hydrometric Bureau, who in Canadian Government Exhibit 9 report the conclusions they reached by a study of these data.

When it is again pointed out that the water in the district drain ditches was being held at a higher level than would prevail under free drainage conditions and that this level was higher than the proposed storage level, any apprehension as to the effect of the storage level upon the water table of the land becomes groundless.

Encroachment of Storage Levels upon Sluice Gates. The applicant's argument is that there will be no encroachment of water even at the level of the maximum storage line upon any district drainage system except that of Districts 8, 6, 11, 7 and 1, and that no damage would ensue to any of these districts were the full effect of the encroachment allowed to take place by leaving the sluice gates open to allow all water possible to enter. The United States Army Engineers as above noted state that only Districts 1, 6 and 7 would be thus affected.

The United States Brief (page 33) admits District 8 would not be affected by the encroachment directly, and repeats the theory that in this and other districts the reduced head between river and "critical" areas must result in lessened seepage from "critical" area to river according to the fundamental hydraulic law.

The applicant points out again that said law is inoperative between low areas and river because of intervening obstacles in the way of a higher water table than either the river or the "critical" area water table in the "levee" or "other" area land between the two; to assert that seepage was so taking place is to assert that water will flow uphill.

Alternatively, if additional water entered the drainage system of said districts in consequence of the higher storage level and it was undesirable, the question reduces itself to the amount of additional pumping required in said three districts to keep the water at the desired level.

Objections to the Application. The United States Brief quotes a paragraph from the Applicant's Brief commencing "Assuming for the moment that the Newell and Jessup studies of the critical area are representative." It then proceeds to attack the statement of the applicant that if the complete story is to be given to the Commission it must be pointed out that the Newell-Jessup studies took into account only those areas of the districts which might be damaged and wholly neglected to mention the benefits which might accrue to the higher lands by reason of a raised water table. The United States

Brief overlooked the obvious fact that this was an assumption merely, and that the applicant took up this position for the sake of argument only. Far from intimating that the results of the Newell-Jessup studies are correct, the applicant has repeatedly shown the Newell-Jessup results to be erroneous throughout.

The United States Brief then proceeds to state that in any event the extent of the land bordering the "critical" areas that would be benefited by higher water table is small, and it is irrelevant to discuss the benefit that would ensue because, as previously argued by the United States Brief, no consideration is to be given to any benefits that would accrue, and that the extent of injury only is to be determined. In the first place, the United States Brief does not refer to the source of the evidence that establishes that the area to be benefited is small, and there is no such evidence that could be referred to. In the second place, the argument that injury only is to be considered has already been dealt with in this reply. By reverting to this argument the United States Brief here accentuates how untenable its position would be in the event that the area to be benefited by an increase in the level of the water table, if it could be caused by the applicant's storage, should be very great; and the lower area where such an increase in water table might do injury, might be very small so that it would be advisable in the interest of the whole area to flood the low area for the sake of getting the benefit in the larger area where an increase of water table level would be of benefit. And if the applicant's storage proposal did give this beneficial result, the United States Brief would argue that the right should not be given the applicant to do so because some injury was being caused to the smaller area of lower acreage. Such a position is unreasonable and untenable.

Pages 46 to 57 of the United States Brief consider the applicant's complaint that in the Newell-Jessup studies the base data were determined at a time when water was being held within the sumps and drains of the districts and that the base data were affected in varying and unknown degrees by this artificial condition. The Brief observes that the evidence on which the applicant bases its assertion in respect to this matter is not cited. Also that it is not indicated whether the applicant considers that objectionable conditions were allowed to exist in only one year or in more than one year.

With respect to the complaint that the evidence that the water was being held in sumps and drains is not cited in the Applicant's Brief, the applicant would bring to the attention of the Commission that in its Brief, pages 59 to 73, there are well over fifty citations of evidence taken from the Newell Exhibits establishing the fact that the water levels were artificially held at higher than natural levels. Furthermore, on pages 34 to 37 of the Dominion Government's Brief, there are over ten citations from the Newell Exhibits establishing this fact.

With respect to the complaint that it is not indicated whether the applicant considers that objectionable conditions were allowed to exist in only one year or in more than one year, the attention of the Commission is called to the Applicant's Brief, pages 59 to 73, where continuous references are made to these conditions as obtaining in the years 1930, 1931 and 1932. Many similar references are made in the Dominion Brief, pages 34 to 37.

In proceeding to discuss this phase, the United States Brief states on pages 46 and 47 that:—

> "There can be no doubt that, as stated on page 46 of the Applicant's Brief, the 'holding of water in the drainage ditches and within the so-called critical areas must of necessity raise the water table within these adjacent areas.' The holding of water in the drainage ditches would cause the water table to rise for the same reasons that raising the river levels would cause the water table to rise. The same principles apply.

"There can be no doubt that it is desirable to have the data collected in a study of this character as free as possible from modifying influences. The engineers, however, did not create the conditions which they were called upon to study. They studied actual conditions as they found them to exist. The data submitted to the Commission represents conditions as they were found. Mr. Newell, of course, was not in position to direct the management of the drainage districts how they should operate the districts. He studied conditions as he found them. The management of the districts were entitled to operate their districts as they saw fit.

"It is stated in Applicant's Brief, page 46, that the artificial conditions of which complaint is made, resulted 'from the action of the district owners or other parties in closing the gate in the gravity outlet, or preventing the function of these drains by dams or other obstructions during the natural drainage period.'

"The presence of water in the drains at elevations higher than river levels seems to be relied on as conclusive evidence that 'the district owners or other parties' closed the gates to prevent the escape of water from the drains. It has not been shown that the gates were deliberately closed by 'the district owners' or by 'other parties.'"

It is submitted that the foregoing statement from the United States Brief is a practical admission that the water levels in the so-called "critical" areas were held at artificial elevations during the period of investigation. It is also an admission that the holding of the water in the drainage ditches would cause the tributary water table to rise. It is also an admission that it is desirable to have the data collected in a study of this character as free as possible from modifying influences.

It is respectfully submitted that neither the Applicant's nor the Canadian Government Brief intended to imply that the water levels in the so-called "critical" areas were artificially held at higher levels than those which would result from free run-off conditions in the ditches, for the purpose of influencing the studies. The one and only position which was taken in this connection in the Applicant's and the Canadian Government Briefs was that it was a fact that the water had been held at an artificially high elevation and that this condition must necessarily have resulted in maintaining the tributary water table in the so-called "critical" areas at an artificially high elevation.

The position of the Dominion Government as submitted in its Brief, page 70, is to the effect that:—

"These higher levels in the ditches and in the sumps must have been so held knowingly and purposely by the district owners. There can be only one possible reason for the holding of these sump and ditch levels at these higher elevations and that reason is that, as a result of such holding it was anticipated that the crop production would be bettered. No representations have been made that the crops in these districts have been other than satisfactory. That the effects of holding the water *were* satisfactory is demonstrated by the fact that water was held during each year of the investigation."

The final submission of the Dominion Government Brief, page 71, in this matter may be repeated, i.e.,

". . . that apart altogether from theoretical deductions as to whether or not the company's storage proposals will have the effect of raising the water table in the drainage districts, *the practical effect of such raising upon crop production has already been completely demonstrated in many of the districts,* and that such effect is beneficial rather than detrimental to crop production. It is submitted that no further practical demonstration is required."

On page 52 of the United States Brief it is stated that the claim in the Applicant's Brief to the effect that "critical" areas were determined at a time when water was being held within the sumps and drains of the district, is inaccurate. The Brief makes reference to data in Newell Exhibit No. 6 to show that the gate in each district was not closed until after April 1 in 1930. The Applicant's Reply then cites many references from various Newell exhibits, giving the data from the United States Geological Survey water table study in proof of its statement that an artificial condition had been created throughout the full period of the water table study by the maintenance of higher than natural water levels in the drainage ditches of the districts, many of which would have a greater influence upon the water tables under study than the proposed storage levels would have if their greatest possible effect were being freely permitted by leaving the sluice gates open to allow the higher water of the storage levels free access to those districts where encroachment is possible.

The Inventory Method of Analysis. Specific reference to the Inventory Method of Analysis is made on pages 57 to 74 inclusive of the United States Brief. Throughout these pages the attempt is made to justify in response to applicant's criticism, not only the adoption of the Inventory Method of Analysis to the problem of ascertaining the effect of the proposed storage levels on the water table of the so-called "critical" areas in the Idaho drainage districts, but also the values applied to the different contributing and dissipating agencies entering into the analysis and hence the conclusions reached.

As a result of the detailed review of the various assumptions made in the Newell Exhibits, the applicant concluded that the Inventory Method of Analysis was not applicable to the Kootenay valley and that the results obtained in the Newell Exhibits, being dependent on this method, are in the last analysis merely assumptions which the results of the studies of the engineers of the Dominion Government and of the applicant show to be in serious error.

While admitting that assumptions were made, the United States Brief attempts to meet and refute some of the criticisms made by the applicant in respect to the said assumptions. It is respectfully submitted that this refutation is not convincing. In this connection consideration will be given: First, to the uncertainty of the assumptions; and Second, to the non-applicability of the Inventory Method to the conditions obtaining on Kootenay Flats.

In the first place, with regard to the uncertainty of the assumptions which were made in the application of the Inventory Analysis to the Kootenay problem, it has already been pointed out both in Appendix 1 of the Dominion Government Brief and in pages 48 to 58 of the Applicant's Brief that all the factors entering into the Inventory Analysis of the Kootenay drainage districts, involved, through lack of records, assumptions which contributed to a greater or lesser extent to the discredit of the results obtained and the conclusions reached.

In the United States Brief some attempt is made to refute the importance of certain of the criticisms made by the applicant, but the basic criticism that the analyses of the districts were applications of a theory in which the values applied to the various factors entering into that theory were assumptions and subject to considerable error, has not been disproven. It is freely admitted that assumptions were used and as a matter of fact the discussion in the United States Brief further exemplifies the extent to which assumptions entered into the analyses of the districts.

In the second place, with regard to the non-applicability of the Inventory Method to the conditions obtaining on Kootenay Flats, the actual water table records in the "levee" and "other" areas provide definite evidence.

In the Newell studies the Inventory Analysis is being used to ascertain the seepage of water from the water table of the low-lying areas of each of the

drainage districts in Idaho to the Kootenay river or vice versa in relation to the difference in elevation of the water table of each so-called " critical " area and the level in the river opposite. This application of the Inventory Analysis completely overlooks the existence of the " levee " and " other " areas, between the low lands and the river, in which areas the water table conditions may be and in many cases are such as to prevent ground water movement between the so-called " critical " areas of the districts and the river.

The hydraulic laws repeatedly referred to in the United States Brief do not warrant one to consider only the relative elevations of the water table in a particular section of land located some distance away from the river and of the river itself, and at the same time ignore either the type of material or the elevation of the water table in the land between that being considered and the river, as has been done in the application of the Inventory Analysis to the Idaho Drainage Districts.

If one were to accept the principle that seepage is dependent only upon the difference in head and the distance between two given points without considering the intermediate conditions, as has been done in the Newell studies between the so-called " critical " areas and the river, then a new factor would enter into the Inventory Analysis of the Kootenay Flats. This factor would be the seepage from the " critical " areas to the Pacific Ocean. The distance is in the neighbourhood of 300 miles and the head opportunity is in the neighbourhood of 1,750 feet, whereas between the " critical " area and the river the distance is say 1 to 2 miles, while changes in head opportunity of less than one foot are being considered. This idea of seepage from the Kootenay Flats to the Pacific ocean is absurd but it is just as absurd to assume that there is seepage from the " critical " areas to the Kootenay river when the actual recorded conditions in the intermediate " levee " areas show that seepage cannot occur unless water will flow uphill.

That the level of the water table in the " levee " and " other " areas is such as to condemn results obtained by a process which ignores these levels has already been shown. It is, therefore, reaffirmed that the submission in the Canadian Briefs to the effect that the application of the Inventory Method of Analysis is not applicable to the conditions obtaining on the Kootenay Flats, is wholly warranted.

Conditions Prevailing in the Drainage Districts during the Newell Critical Area Study. Each district is dealt with individually in the Applicant's Brief, but reference will be made here only to Districts 7 and 4 as they were the districts chosen by Mr. Newell for his detailed study.

With respect to District 7, the applicant properly concluded at page 63 that there could be no argument against the statement that the water was higher in the drain ditches of District 7, even in those ditches within and adjacent to the " critical " areas, during the late winter and spring of 1931-32, than it could possibly be under the storage scheme, even if the gates were left open and the water allowed to enter the ditches from the river, and that therefore Mr. Newell ascertained the " critical " area and the " critical " period for the " critical " area in District 7 under conditions that were artificially made worse than they could possibly be had the applicant's proposed storage been in operation.

With regard to District 4, the applicant shows at page 64 of its brief that for the year from October 1, 1930, to September 30, 1931, the water in the drain ditch at the sump was always from 6 to 8 feet above the proposed storage level, and that actually in this district the water in the drain ditches during the late winter and spring of 1931 was 1 to 2 feet higher than the water in the " critical " area wells. Substantially the same conditions prevailed during 1932.

The United States Brief has not challenged these figures and in fact at page 77 has stated that the figures are correct with regard to District 7 in the

following words: "The position of the water held in the drain ditches in District 7 during the test is accurately described in Applicant's Brief but the deductions therefrom are erroneous." With regard to District 4, the United States Brief discusses the first of the figures given by the applicant on this subject, but does not challenge them, and the applicant takes it that all figures giving the artificially increased levels of water in the drainage districts are accepted, since they were taken from the basic data filed by Mr. Newell, and only the deductions that the applicant made therefrom are challenged.

Many pages of the United States Brief are taken up in attempting to refute the deductions made but one deduction that the applicant claims cannot be challenged is that these artificially maintained levels within the drains of the districts and even in the drains immediately in or adjacent to the "critical" areas of the districts, must prove that no worse conditions will prevail in the districts after the storage is in effect than prevailed in the district during the period of the water table investigation; that those who were farming in the districts realized from experience that it was in the interest of the districts to attempt, so far as possible, to create a higher water table in the land in order to improve their crops during the following year; that even though such action raised the water table in the low land sufficient benefit accrued from the increasing of the water table in the other land that needed a higher water table, to justify even the chance of a loss of some crop in the low district. By making this statement the applicant is not admitting that any such loss occurred in consequence thereof.

Reply to Brief of the State of Idaho. It is not necessary to summarize the Applicant's Reply to the Idaho Brief as all points of merit have already been fully discussed while dealing with the United States Brief.

Conclusion. Nothing in the United States Brief nor in the State of Idaho Brief has in any way weakened the conclusion found in the Applicant's Brief, pages 97 to 99. The applicant claims a possible lowering of Kootenay river in Idaho of as much as 4·56 feet. The United States Brief admits that a lowering of as much as 4 feet might be realized but that any lowering in excess of 3 feet could be produced only by a combination of very favourable circumstances. The United States Brief further admits that the lowering which it concedes will be effected will bring substantial benefit to the reclaimed lands in Idaho.

The applicant has shown that the reduction in flood level of from 1 to 2 feet would have meant the difference between serious loss and small loss in six out of the last twenty years.

The works proposed by the applicant to give the aforesaid flood relief, being the Corra Linn control dam and the excavation of Kootenay river at and below Grohman narrows, have been found by earlier investigators on behalf of the United States Government and the Governments of the State of Idaho and the Province of British Columbia, and private parties investigating the subject solely in the interests of Idaho and British Columbia reclamation projects, to be an essential part of the reclamation of Idaho and British Columbia lands, constituting a cardinal feature thereof, but costing too much for the lands to be reclaimed to bear. The applicant proposes to give this part of the reclamation program to the reclamation interests free of cost. The United States Army Engineers, having before them the applicant's application for storage, after weighing the benefits of flood relief against the possible injury by the higher levels of the storage, completely endorse the application as in the best interests of Idaho.

The applicant asks the consent of this Honourable Commission to increase the levels of Kootenay river in Idaho during the months from September to

about the end of March, by about the same amount that it would decrease the flood levels, the highest increase in level being 3·98 feet in January of each year.

A study of the water table of the reclaimed lands, lasting two and a half years, was made by the United States Geological Survey assisted by the applicant, which study it was found was made under conditions more severe than could have prevailed if storage had been in effect, in that the water in the ditches within the districts involved and even adjacent to and within the low or so-called " critical " areas, was held at a higher elevation than it would have been had the increased storage levels been in effect and had it been allowed to find its natural level within the districts. But even under these conditions the data produced in evidence from this water table study shows that the water table of the low or " critical " area will not be raised by the Applicant's storage proposal.

Against the actual facts found by said study, however, the United States Geological Survey engineers have advanced a theory called the Inventory Method of Analysis, which Mr. Newell stated to be as accurate as the auditing of a set of books, but which the applicant and the Canadian Government in their respective Briefs point out depends upon many uncertain factors, the value of which in the construction of the theory had to be assumed by the United States engineers and were subject to such a degree of change or error as to make it possible, by assuming different values, with equal justification to reach the opposite conclusion. That the values of many of such factors assumed by the United States engineers were assumptions, is admitted by the United States Brief. Furthermore, if the conclusion derived from the Inventory Analysis Method were correct, which the applicant denies, it amounted only to the conclusion that certain low areas would have a higher water table after storage was in effect, to their injury, and certain other areas adjacent to said low areas where a higher water table was needed would have their water table increased, to their benefit. This in spite of the fact that if the theory would apply after storage it must have already applied, because of the artificially increased levels of the water in the ditches.

There is no other proof of injury either in theory or in fact advanced by United States interests, and the subject therefore comes to the point of weighing (if the conclusion derived from the theory is accepted) whether or not the possibility of some injury occurring to this lesser acreage of low land or so-called " critical " area within each district is greater than the benefit that will ensue to the areas surrounding the low areas where the alleged increased water table would be beneficial, plus the possibility of saving from flooding the entire area of the district in six out of every twenty years, at a time of the year when the cost of cultivation has already been incurred.

Once again the applicant respectfully submits that the United States Army Engineers, in Canadian Government Exhibit 8, page 29, have recorded an appropriate summary in the words now quoted, being paragraphs 94 and 95 of said report:—

> " 94. In connection with the dam and compensatory works proposed by the West Kootenay Power and Light Co., it seems that the use of storage as proposed is desirable for the highest utilization of the potential power in the Kootenay and in the Columbia, and the compensatory works will be of benefit during the flood stages to all overflow lands in the valley above the lake, in Canada as well as in the United States, in that it will increase the discharge capacity of the river.
>
> " 95. The reclaimed areas in Idaho are at present probably subject to the possibilities of greater damage from floods during the summer season than from improper drainage of the sub-soil due to raising the water table during the fall and winter months."

Power interests of the Columbia river in the State of Washington will derive substantial benefits from the storage of water applied for.

The works already constructed and those proposed to be constructed by the applicant without cost to the reclamation interests will lay the foundation for further improvements at Grohman, Proctor narrows and other control points, affording additional relief from flood hazard at small expense.

Because such substantial benefits will accrue to all United States interests and particularly to the reclamation interests in the State of Idaho, and because no damage will be done and no additional expense incurred by Idaho interests, the applicant had hoped that after the full and complete study that has followed since the filing of its application, all Idaho interests would have been willing to agree that the application be granted unconditionally.

Since this result has not been achieved and both the United States Government and the Reclamation interests are still objecting to the allowance of our application, the applicant in deference to the fears of the objecting parties has decided not to press its application further than to be allowed to complete the record by filing its printed reply to the United States Brief and the Idaho Brief and respectfully requesting an opportunity for the Canadian Government to file its reply if it so desires, and thereupon the applicant will withdraw the application.

Summary of Reply Brief Submitted on Behalf of His Majesty's Government in Canada

The "Reply Brief filed on behalf of the Government of Canada" October 2, 1934, by J. E. Read, K.C., Legal Adviser, Department of External Affairs, may be summarized as follows:—

The opening paragraphs of the reply brief explain that it is not the intention to cover the entire case but "to summarize the basic features upon which there is substantial agreement and to discuss the only point upon which there is a substantial, factual difference of opinion." With regard to this one point of difference—whether or not damage will be caused to the reclamation districts by the raising of low water levels—the hope is expressed "that the Commission will be satisfied that the view taken by the Canadian Government engineers is correct." However, it is pointed out that it is conceivable that the Commission may not be willing to accept this view, and that accordingly the brief will conclude with a discussion of "the situation that would arise if it is assumed that damage will be caused by the raising of the water levels."

The brief follows with a short statement of the basic features upon which there is agreement and a discussion of the question of damage to the drainage districts in which it is reiterated that the applicant's proposals will not have any injurious effect on the agricultural value of the land in the drainage districts.

Based on the assumption that damage would be caused by raising the water levels as proposed by the company the Reply Brief states the following:—

"*Whether benefits to the reclamation districts resulting from the project should be balanced against possible damage caused by storage.* Having concluded examination of the basic features in this case upon which there is agreement and of the one point upon which there is a substantial factual difference of opinion, it becomes necessary to examine the situation that would arise if the Commission should be inclined to reject the views submitted on behalf of the Canadian Government on the last point. It is submitted that the Commission should accept the views presented by the Canadian engineers and decide that no damage will or could be caused to the reclamation districts by reason of the raising of the water levels in Kootenay lake and in the river during the low water season. On the other hand, even if the Commission is unable to

accept this view, it is submitted that the Commission would be justified on the evidence presented in granting the application, without making any specific provision for damage. It is assumed, purely for the purpose of argument, that the views on questions of fact presented in the United States Government brief are sound, and that Mr. Newell's inventory analysis, with its resultant theories, and Mr. Jessup's conclusions, are justified. The case will be discussed upon the theory that the Company's proposal would lead to a diminution in the natural drainage of the lands during the low water season, and a consequential raising of the water tables. Upon this assumption, it would have to be admitted that the storage proposals would cause damage to the drainage districts, and that the measure of that damage would be the cost of the increased pumpage which would be necessary to counteract the effect of the winter storage. No evidence has been presented, either by the United States Government or by the districts, as to the cost of such increased pumpage. We can only assume that it would be moderate in amount. The position then would be that the storage proposals upon these assumptions would involve an admitted benefit to the drainage districts, and an admitted detriment. It is submitted that the Commission in such circumstances would be bound to strike a balance in order to determine the amount of indemnity that should be paid, if the detriment exceeds the benefit; or in order to determine that no provision for indemnity was necessary, in the event that it is found that the benefit accorded the districts exceeds the detriment.

"In attempting to strike this balance without the aid of specific figures, either as to the value of the benefit or of the detriment, it is necessary to look at the situation from a common-sense business point of view. It has been established by the series of reports of earlier investigations presented by Mr. Johnston at the Nelson hearing, and from the Army Engineers' Report, that an essential element in a sound project for reclamation in the Kootenay Flats, is an adequate scheme of flood control. The machinery of such a scheme of flood control must include three elements, namely, a control dam, excavation at the outlets, and a regime of regulation with a view to lessening flood damages in the low-lying lands in Canada and the United States above the head of the lake. The evidence has established beyond all possible doubt that it would be worth while in the interests of reclamation to build the dam, excavate the outlets and establish the system of control.

"It is common ground that Corra Linn furnishes an adequate control dam. It is common ground that the proposed excavation at Grohman would form an important part of the outlet excavation necessary for flood control and that, even without additional excavation, it would have a substantial beneficial effect. It is common ground that any order given by the Commission in these proceedings should be so drafted as to secure as a matter of right, an adequate system of flood control inuring to the benefit of the reclamation districts.

"Accordingly, Corra Linn, the excavation at Grohman narrows, the facility for further outlet excavation if necessary, and the right to an adequate system of control, must be regarded as real and tangible assets placed on the credit side of the account as a result of this application; assuming, of course, that it is granted. On the debit side, is the possible need for additional pumping,—and at this stage we are assuming, for the purpose of argument, that it is an actual need. To assist in striking a balance in this account, the members of the Commission have viewed the assets on the credit side of the account and have had an opportunity for examination of the reclamation districts, thus forming a judgment as to the possible cost of increased pumping. It is submitted that the Commission would be bound to conclude that the assets on the credit side would exceed in value, from the purely reclamation point of view, the debits on the other side of the account. In coming to such a conclusion, the Commission will be assisted by the considered judgment of the Army Engineers as expressed in their report which was presented at Nelson by Mr. Johnston.

"In the United States Government brief, at pp. 126 to 130, it is argued that the Commission would not be justified in taking into consideration the benefits that would accrue in the United States as a result of the carrying out of the company's project.

"It is not contended that an applicant in such circumstances would be justified in setting off a benefit accruing to one interest against damage suffered by another interest, as the result of the construction of a work. At the Nelson hearing, representations were made on behalf of the Canadian Government, pointing out the very great benefits that would accrue in the State of Washington as a result of the Kootenay storage. These were regarded as relevant to the issue of whether or not the application should be granted and were not discussed in relation to the issue of indemnity. In the brief the question of benefits was discussed at pages 57 to 66, and the possibility of further excavation at the lake outlet, at page 72; and at pages 76 and 79, it was argued that as the project was, on balance, beneficial to the Idaho interests, there should be no provision in the order for indemnity.

"This matter raises a very important question on the interpretation and application of Article 8 of the Boundary Waters Treaty. In discussing this question of interpretation, the 6th and 7th paragraphs of this Article should be considered.

Para. 6.—The Commission in its discretion may make its approval in any case conditional upon the construction of remedial or protective works to compensate so far as possible for the particular use or diversion proposed, and in such cases may require that suitable and adequate provision, approved by the Commission, be made for the protection and indemnity against injury of any interests on either side of the boundary.

Para. 7.—In cases involving the elevation of the natural level of waters on either side of the line as a result of the construction or maintenance on the other side of the remedial or protective works or dams or other obstructions in boundary waters or in waters flowing therefrom or in waters below the boundary in rivers flowing across the boundary, the Commission shall require, as a condition of its approval thereof, that suitable and adequate provision, approved by it, be made for the protection and indemnity of all interests on the other side of the line which may be injured thereby.

"These paragraphs require the Commission to make suitable and adequate provision, for the protection and indemnity of all interests on the other side of the line, a condition of its approval.

"In interpreting this article, the general nature and functions of the Commission which have been discussed at some length in the brief should be considered. The statement there made will not be repeated. The primary function of the Commission is to enable the great natural resources, which are affected by the international boundary, to be developed in the interests of both countries, in a fair and just manner. It has been the policy of the Commission in the past to bring about the same results as if the international boundary did not exist, and as if the natural resources in question were wholly on one side or other of the international boundary. Such a policy is, I submit, amply justified by the terms of the treaty, and thoroughly implements the obvious intention of both of the High Contracting Parties.

"In stipulating suitable and adequate provision for the protection and indemnity of all interests on the other side of the line which might be injured by an authorized work, it may be observed that the High Contracting Parties deliberately used the word "indemnity," which, both in ordinary language and in legal parlance involves the conception of placing the person in question in the

same position as he would have been in had the project not been carried out in so far as monetary provisions can accomplish such a result. This would necessarily involve the taking into account of the benefits received and injury suffered, and striking a balance. The Treaty does not provide that the landowner should be charged with any credit balance thus resulting, but it clearly assumes that in any claim for indemnity he should set off the benefits received in respect to the land affected by the work.

"This interpretation would be in accordance with the ordinary principles of law which are applied by the courts in the United States in respect of the exercise of the power of Eminent Domain. When a person claims compensation arising from the compulsory taking of an easement upon his land, the rule of law applied by the courts is that the measure of compensation is the difference in the value of the property before the imposition of the easement and after such imposition. A court dealing with a problem of this sort would necessarily take into account both debits and credits. I may say that the contention advanced on behalf of certain landowners whose lands were being partially flooded in the Lake of the Woods to the effect that the rule of law, to which I have just referred, should not be applied, was decisively rejected by the Circuit Court of Appeals at St. Louis and by the Supreme Court of the United States this year, in the case of Olson vs. United States of America.

"In making this argument, it is not suggested that the Commission is necessarily bound by the rules which are followed by the courts. On the other hand, it is submitted that the Commission would not go far wrong in applying these basic principles. The Commission could not be criticized for failure to afford suitable and adequate provision for the indemnity of the interests concerned, if it applied the same principles that the courts of the United States would have applied, had Corra Linn been situated in the State of Idaho and the matter brought before the federal courts of the United States for adjudication.

"It is not anticipated that anyone will seriously question the foregoing statement of the principles of law applied in the two countries, in dealing with similar problems. Consequently, no effort will be made to make an extended argument on the point. It will, presumably, be conceded that in exercising the power of Eminent Domain, the benefits accruing to an owner of land in respect to his holdings, remaining after the expropriation, can be set off in estimating compensation.

"There is one minor aspect of this phase of the problem which is raised on page 128 of the United States brief. It will not be contended that there could be set off against injury to one district, benefits accruing to another; or that there could be set off against damage to certain land in the same district, the benefits accruing to other lands. That problem does not arise in this case. The benefits and detriments accrue to each of the districts in the same manner. The benefits accrue to the district as such, and the burden of the injury, if any, falls upon the district as such; and not on any individual landowners, because it is on the district that the burden of the pumping and drainage falls. There is nothing on record to suggest that in respect to any one district the anticipated injury would exceed in value the benefit accruing from the proposals, and it is equally clear from the records that, with respect to any one district, the burden of increased drainage and pumpage would fall upon the district as a unit, and not upon any particular landowner."

For the purpose of completing the record Mr. Read dealt with a number of points in appendices to the reply brief. These are summarized as follows:—

Appendix A—Possibility of Further Additional Excavation. In this appendix it is pointed out that the United States Brief, pages 15 to 18, comments only upon the 250,000 cubic yards of excavation proposed by the applicant com-

pany at Grohman narrows and does not take cognizance of the 717,819 cubic yards of material which has already been removed from the river channel between Granite and Corra Linn dam.

The attention of the Commission is called to the fact that the completed and proposed excavation constituting nearly 1,000,000 cubic yards of material will be " a very long step in the direction of a full realization of the correct and only practicable scheme for the control of flood levels and for the ultimate satisfactory reclamation of the Kootenay Flats lands."

It is pointed out that the excavation is completely in line with the recommendations of past investigators and that the project has received the endorsation of the engineers of the United States War Department.

It is also pointed out that the excavation is being effected at no out of pocket cost to the districts and that with the 250,000 cubic yards removed the way is open to effect mutually satisfactory arrangements for further additional excavation.

Appendix B—Earlier Investigation. In Appendix B exception is taken to the argument advanced in the Brief of the United States Government with respect to the relevancy of the submission of the results of earlier investigations into the reclamation of Kootenay Flats in relation to the proposal before the Commission.

The United States Brief argues that the plans and expected results of the earlier investigators should be compared in detail with those of the applicant. On the other hand the Reply Brief of the Canadian Government states that the United States Brief has entirely missed the point of the submission with respect to the earlier investigations, viz., " that *it is the consensus of all engineering studies which have been made into the reclamation of the Kootenay Flats,* that the lowering of the levels of the river and lake during periods of high water by excavation at the lake outlet constitutes *a cardinal feature of the successful reclamation of the Flats,* and that the excavation proposals of the applicant constitute a long step towards a realization of this successful reclamation."

Appendix C—Report of United States Army Engineers. Appendix C of the Reply Brief rebuts the submission of the United States Brief that the United States Army Engineers were not referring to the possible raising of the water table under the applicant's proposals in the following paragraph from page 29 of the Army Engineers' Report (Canadian Government Exhibit No. 8):—

> " 95. The reclaimed areas in Idaho are at present probably subject to the possibilities of greater damage from floods during the summer season than from improper drainage of the subsoil due to the raising of the water table during the fall and winter months."

Argument is advanced to show that the Army Engineers had definitely in mind the possibility of interference with drainage as a result of the applicant's storage proposals.

The reply concludes as follows:—

> " It is accordingly submitted to the Commissioners that the opinion of the Army Engineers of the United States War Department is clearly stated in their report, and that this opinion is that the benefit value of the lowering of the water levels resultant from the applicant's excavation proposals more than balances any possible damage to the drainage districts from the applicant's storage proposals. (Page 69 Government of Canada Brief.)"

Appendix D—Possibility of Dikes being Bettered to Withstand Floods. —Appendix D discusses the suggestion contained in the United States representations to the Commission to the effect that with the passage of time the dikes

will probably be improved to withstand higher and higher floods, thus diminishing the benefits to be derived from the proposed excavation at the lake outlet.

It points out that this suggestion constitutes "*a direct admission that further protection against high water is essential to the safety of the districts,*" and it continues "The fact that this betterment to the dikes can only be secured by the direct expenditure of funds by or on behalf of the district owners is furthermore *direct evidence of the financial value to the districts of the additional safety factor against floods which would be introduced as a result of the applicant's excavation proposals at the lake outlet.*"

The appendix quotes from the 1931 report of the Engineers of the United States War Department to the effect that increasing the height of the dikes in Idaho is infeasible and unsafe. It also points out that higher dikes will accentuate high water troubles.

Appendix E—Citation of Basic Data Establishing that the Water Level Was Artificially Held in the Drainage Districts. In rebuttal of statements made in the Brief of the State of Idaho, Appendix E contains lists of citations from the Brief of the Government of Canada and from the Applicant's Brief, respectively, of references to base data filed in the United States Exhibits which establish that water was held in the ditches and sumps of certain of the drainage districts during the low water periods of 1930-31 and 1931-32.

APPENDIX

CONTENTS

Creston Project

Kootenay Farm

Granite Dam

Corra Linn Dam

A

TO THE HONOURABLE THE INTERNATIONAL JOINT COMMISSION

Application made by Creston Reclamation Company hereinafter called the Applicant, for permission to construct and operate certain permanent works in and adjacent to the channel of the Kootenay River in the Province of British Columbia at a point at or near Creston, in the said Province of British Columbia, respectfully sheweth:—

1. Status of the Applicant.

The applicant is a corporation duly incorporated as a limited company under the provisions of the Companies Act of the Province of British Columbia, a copy of the certificate of incorporation bearing date 14th day of December in the year of Our Lord, one thousand nine hundred and twenty-five and a copy of the Memorandum of Association of the Creston Reclamation Company, Limited, together with a certificate under the hand of the Registrar of Companies of the Province of British Columbia bearing date 4th day of January, in the year of Our Lord, one thousand nine hundred and twenty-six, entitling the company to commence business, are set forth as appendices I, II, and III respectively hereto.

The head office of the applicant is at the village of Creston in the province of British Columbia in the Dominion of Canada.

The directors of the company are: Clarence Franklyn Hayes of Creston, British Columbia, Editor; George Johnson of Creston, British Columbia, Butcher; Samuel Arthur Speers of Creston, British Columbia, Merchant; Cecil Watson Allan of Creston, British Columbia, Bank Manager; Hugh Stuart McCreath of Creston, British Columbia, Merchant.

The capital stock of the applicant is $50,000.00 divided into 50,000 shares of $1.00 each, 3,400 of which have been issued and paid for. The list of subscribers to capital stock is set forth in appendix IV hereto. By the Memorandum of Association of the applicant, set forth in appendix II hereto, the applicant has power, among other things, by paragraphs (*b*) and (*c*) of the objects for which the company is established:—

(*b*) To undertake, construct and maintain upon any land owned or leased by the Company, or in which the Company has any interest, operations for the purpose of reclaiming and bringing under cultivation such land or part thereof.

(*c*) To construct, improve, maintain, equip, alter, work, operate, manage, carry out or control any roads, ways, water-ways, reservoirs, dams, aqueducts, canals, sluices, flumes, tramways, dikes, ditches, bridges, wharfs, manufacturies, warehouses, works, houses, shops, stores, buildings and other works and conveniences which may seem calculated, directly or indirectly to advance the Company's interest. And to contribute to, subsidize or otherwise aid or take part in any such operations though undertaken, constructed or maintained by any other person, persons or company.

2. The applicant proposes by the construction of a levee or dike to reclaim certain lands adjacent to the Kootenay river.

The applicant proposes to reclaim a portion of the lands adjacent to the Kootenay river near Creston, B.C., that are flooded yearly by the flood waters of the Kootenay river, and make these lands commercially valuable for agricultural purposes.

The reclamation project as planned will consist in constructing a levee or dike around the lands to be reclaimed to an elevation well above flood level; to construct the necessary drainage ditches in the same, and to construct the necessary Centrifugal Pumping station to pump out all storm water and seepage water from the reclaimed lands.

These levees will be constructed well back from the top of the river bank, and will in no way interfere with the natural flow of the Kootenay river, excepting in such years as the flood overtops the river bank, happening on an average of one year in four years. The River banks through the Kootenay flats are approximately 20 to 24 feet above low water in the river, and from 12 to 14 feet above the general level of the land to be reclaimed.

The Kootenay River flats extend from Kootenay Landing in British Columbia to above Bonners Ferry in Idaho, a distance in an air line of 45 miles, of which 20 miles is in British Columbia. Of these lands it is estimated that 30,000 acres in British Columbia, and 30,000 acres in Idaho can be reclaimed for agricultural purposes by diking and ditching as is proposed to be done by the Creston Reclamation Company in Unit No. 1.

In the State of Idaho approximately 18,000 acres of these lands have already been reclaimed and cropped, of which Unit No. 1 at Bonners Ferry consisting of 5,000 acres has been cropped each year since 1922 with great success so that the feasibility of the reclamation is well established.

3. Description of the work and plans submitted.

There is submitted with this application the following plans on tracing linen:—

(1) Plan showing the contour lines on the land proposed to be reclaimed in Unit No. 1, as well as the location of the levees or dikes, etc., etc.

(2) Plans showing the cross section and details of the work to be constructed.

(3) General plan showing Kootenay river flats in British Columbia from Kootenay Landing to the international boundary.

(4) The specifications for the construction of the necessary work in Unit No. 1.

The Kootenay river flats in British Columbia it is proposed to reclaim in units as is being done in the State of Idaho. The first unit to be reclaimed is Unit No. 1, comprising 8,600 acres, No. 2, unit will be west of the river and immediately west of No. 1 unit.

4. Effect of proposed works on international waters.

The effect of the construction of the proposed works of the British Columbia Unit No. 1 on International waters is merely nominal, it will have no effect whatever on low water, and during flood water it is merely intended to keep the flood water off the land reclaimed.

When, however, the whole area of the Kootenay river flats on both sides of the International boundary line has been reclaimed by the method proposed, and the banks on both sides of the river are raised by the levees or dikes to a height of 5 feet above the 1916 flood as is proposed, and the flood waters are confined within the river banks, then in the occasional year that the flood would be higher than the natural river banks, and this flood is kept within the levees, the peaklevel of the flood in the river will be somewhat higher than in its natural state. The river surface also will assume an hydraulic gradient greater than the normal one, with an increased velocity of flow.

This application is therefore respectfully submitted for your consideration.

Petition.—The applicant company does now pray for such order, ruling or decision, authorizing and empowering the applicant company to proceed with the said works as may in the opinion of your Honourable Commission be required by the "Waterways Treaty Act" together with such provisos as may be deemed fitting in the premises.

All of which is respectfully submitted.

N. G. GUTHRIE,
Solicitor for Creston Reclamation Company, Limited.

October 14, 1927.

Appendix I

CANADA No. 8433

PROVINCE OF BRITISH COLUMBIA

"COMPANIES ACT"

I hereby certify that "Creston Reclamation Company Limited" has this day been incorporated under the "Companies Act" as a limited company.

The capital of the company is fifty thousand ($50,000) dollars, divided into fifty thousand (50,000) shares.

The registered office of the company is situate at Creston in the province of British Columbia.

Given under my hand and Seal of Office, at Victoria, province of British Columbia, this 14th day of December, one thousand nine hundred and twenty-five.

H. G. GARRETT,
Registrar of Companies.

[Seal]

Appendix II

CANADA No. 8433

PROVINCE OF BRITISH COLUMBIA

"COMPANIES ACT"

I hereby certify that "Creston Reclamation Company Limited" is now entitled, under the "Companies Act," to commence business.

Given under my hand and Seal of Office at Victoria, province of British Columbia, this 4th day of January, one thousand nine hundred and twenty-six.

H. G. GARRETT,
Registrar of Companies.

[Seal]

Appendix III

Memorandum of Association of "Creston Reclamation Company, Limited."

I

The name of the company is "Creston Reclamation Company, Limited."

II

The registered office of the company will be situate in the village of Creston, in the province of British Columbia.

III

The objects for which the company is established are:—

(*a*) To acquire by purchase, exchange, grant, lease, or by any other legal title, and to own, hold, improve, operate, lease, pledge, sell, exchange, or otherwise deal in and with real estate and property, both movable and immovable, and rights therein and thereof of every kind and description.

(*b*) To undertake, construct and maintain upon any land owned or leased by the company, or in which the company has any interest, operations for the purpose of reclaiming and bringing under cultivation such land or part thereof.

(*c*) To construct, improve, maintain, equip, alter, work, operate, manage, carry out or control any roads, ways, water-ways, reservoirs, dams, aqueducts, canals, sluices, flumes, tramways, dykes, ditches, bridges, wharfs, manufacturies, warehouses, works, houses, shops, stores, buildings and other works and conveniences which may seem calculated, directly or indirectly to advance the company's interest. And to contribute to, subsidize or otherwise aid or take part in any such operations though undertaken, constructed or maintained by any other person, persons or company.

(*d*) To record, purchase or otherwise acquire water and water-records, rights, privileges and grants and to develope and turn same to account.

(*e*) To enter into any arrangement with any Government or authorities, municipal, local or otherwise, that may seem conducive to the Company's objects, or any of them, and to obtain from any such Government or authority any rights, privileges and concessions which the Company may think it desirable to obtain and carry out, exercise and comply with any such arrangements, rights, privileges and concessions.

(*f*) To undertake upon any land owned or leased by the Company, or in which the Company has any interest, or any part thereof, farming and ranching operations, to market, buy and sell, or otherwise deal in farm and ranch products of all kinds including fruit, vegetables, hay, grain and live stock and dairy products.

(*g*) To carry on a general mercantile business and to manufacture, buy, sell and deal in, all kinds of articles necessary and convenient to be used in connection with the business of the Company, or with the sale of any articles dealt in by the Company.

(*h*) To acquire, hold, manufacture, build, maintain and operate all stock and plant, machinery and appliances necessary for the carrying out of any of its undertakings, and for this purpose to acquire any patent rights, patents, inventions, trade marks, and other similar rights and privileges.

(*i*) Generally to purchase, take on lease, or in exchange, hire, or otherwise acquire any real or personal property and any rights and privileges which the company may think necessary, or convenient, for any purpose of its business, and in particular any land, buildings, easements, franchises, machinery, plant and stock and trade.

(*j*) To acquire by purchase, lease or otherwise water privileges and grants, docks, wharfs and piers and generally all shipping facilities requisite for the company's business and to purchase, or otherwise acquire, sell, dispose of, build, repair and operate steam tugs, gasoline launches and vessels of any description.

(*k*) To sell out the undertakings of the company in whole or in part for such consideration as the company may deem fit, and in particular for shares, debentures, or securities of any other company having objects similar in whole or in part of this company.

(*l*) To invest and deal with the monies of the company not immediately required in such manner as from time to time may be determined.

(*m*) To sell, improve, manage, develope, exchange, lease, mortgage, dispose of, turn to account or otherwise deal with all or any part of the property and rights of the company.

(*n*) To amalgamate with any company having powers similar to those of this company, upon such terms and conditions as may be agreed upon.

(*o*) To enter into partnership, or into any arrangements for share in profits, union of interests, or co-operation with any person, firm or company or persons, firms or companies, carrying on or engaged in, or about to carry on or engage in, any business or transaction which this company is authorized to carry on or engage in, or any business transaction capable of being conducted so as directly or indirectly to benefit this company; and to lend money to, guarantee the contracts of, or otherwise assist any such person or company, and to take or otherwise acquire shares and securities of any such company, and to sell, hold, reissue, with or without guarantee, or otherwise deal with the same.

(*p*) To promote any company or companies for the purpose of acquiring all or any of the property and liabilities of this company or for any other purpose which may seem directly or indirectly to benefit this company.

(*q*) To lend money to such persons and on such terms as may seem expedient, and in particular to customers and others having dealings with the company.

(*r*) To borrow or raise or secure the payment of money in such other manner as the company may think fit, and in particular by the issue of bonds or debentures or debenture stock, perpetual or otherwise, charged upon all or any of the company's property (both present and future) including its uncalled capital, and to redeem or pay off any such securities.

(*s*) To remunerate any person or company for services rendered, or assisting to place, or guaranteeing the placing of any of the shares of the company's capital or any debentures or other securities, or in or about the formation or promotion of the company or the conduct of its business.

(*t*) To draw, accept, make, endorse, discount, execute and issue promissory notes, bills of exchange, bills of lading, warrants, bonds, debentures, and other negotiable or transferable instruments.

(*u*) To obtain any provisional or other order or act or ordinance for enabling the company to carry any of its objects into effect or for effecting any modification of the company's constitution, or for any other purpose which may seem expedient, and to oppose any proceedings or applications which may seem calculated directly or indirectly to prejudice the company's interests.

(*v*) To do all such other things as are incidental or conducive to the attainment of the above objects, or any of them, and to exercise generally all such powers as may from time to time be conferred on this company by Act of Parliament, charter, licence or other executive or legislative authority.

The word "company" throughout this clause shall be deemed to include and mean partnership, associations, or other body of persons whether incorporated or not, and whether registered or domiciled in the province of British Columbia, or elsewhere.

IV

The liability of the members is limited.

V

The capital of the company is fifty thousand dollars ($50,000) divided into fifty thousand (50,000) shares, of one dollar each, with power to divide the shares in the capital for the time being into several classes and to attach thereto respectively any preferential, deferred, qualified or special rights, privileges or conditions.

We, the several persons whose names and addresses are subscribed are desirous of being formed into a company, in pursuance of this Memorandum of Association, and we respectively agree to the number and class of shares in the capital of the company set opposite our respective names.

Name	Address, Description	No. Shares Taken	Class
Chas. O. Rodgers			
Cecil Watson Allan			
George Johnson			
Clarence F. Hayes			
Roy Baird Staples			

Dated this 25th day of November, 1925.

Witness to the above signatures:—

Full name—Edward Clement Gibbs.

Address—Creston, B.C.

Occupation—Deputy Postmaster.

Appendix IV

List of Subscribers to Creston Reclamation Company, Limited

Rodgers, C. O.	$300.00	Henderson, G. B.	$300.00
Staples, R. B.	200.00	Fraser, W.	300.00
Hayes, C. F.	400.00	Scrimgeour, D. S.	100.00
Johnson, George	400.00	McCreath, H. S.	400.00
Allan, C. W	100.00	Crawford, W. H.	200.00
Speers, S. A.	400.00	Constable, G	100.00
Bevan, R. S.	100.00	Garland, C. B.	100.00

B

DEPARTMENT OF EXTERNAL AFFAIRS

CANADA

OTTAWA, April 11, 1928.

SIR,

Creston Reclamation Application:

With reference to the above application, I am enclosing a copy of an Order in Council (P.C. 186) which was passed on February 4, 1928, granting the application of the Creston Reclamation Company, Limited, under section 7 of the Navigable Waters Protection Act, Chapter 140, R.S.C., 1927, for the approval of the plan and site of certain reclamation work proposed to be made in Unit No. 1 of the Kootenay River Flats, near Creston, British Columbia.

I am enclosing also a copy of the plan and description of the site approved.

I have the honour to be, Sir,

Your obedient servant,

(Signed) O. D. SKELTON,
Under Secretary of State for External Affairs.

The Secretary,
International Joint Commission,
(Canadian Office),
Ottawa.

P.C. 186

CERTIFIED *to be a true copy of a Minute of a Meeting of the Committee of the Privy Council, approved by His Excellency the Governor General on the 4th February, 1928.*

The Committee of the Privy Council have had before them a report, dated 26th January, 1928, from the Minster of Public Works, submitting that the Creston Reclamation Company, Limited, has applied, under Section 7, Chapter 115, Revised Statutes of Canada, 1906—the Navigable Waters Protection Act—for the approval of the annexed set of two plans of certain reclamation work, and of the site thereof, according to the description attached, proposed to be made in Unit No. 1, of the Kootenay River Flats, near Creston, B.C.;

That the company has filed the following undertaking with the Department of Public Works in connection with its application:—

UNDERTAKING

By the Creston Reclamation Company in connection with the reclamation work proposed to be made in Unit No. 1 of the Kootenay River Flats near Creston, B.C., in accordance with the plan of the work and the description of the site thereof deposited with the Minister of Public Works of Canada, under Section 7, Chapter 115, Revised Statutes of Canada, 1906—the Navigable Waters Protection Act.

1. The company hereby agrees to be responsible for, and save the Minister of Public Works of Canada harmless from, all claims for damages which may result to the banks, dikes and lands along the Kootenay river.

2. The company further agrees to provide reasonable facilities for the passing of logs and other wood goods on the said Kootenay river affected by the reclamation works in said Unit No. 1.

In Witness Whereof the Seal of the said company and the hands of its proper officers in that behalf have been affixed this 14th day of January, 1928.

CRESTON RECLAMATON COMPANY,

(Signed) C. F. HAYES,
President,

S. A. SPEERS,
Secretary.

That the Chief Engineer of the Department of Public Works, on the report of the District Engineer, has recommended the approval of the application from the standpoint of navigation, subject to the conditions of the above undertaking, and in this recommendation the Deputy Minister of Public Works has concurred;

That the company has furnished proof of its interest in the land to be reclaimed;

That the Department of Justice has reported that all the requirements of Section 7 of the Navigable Waters Protection Act have been complied with and that this application may now properly be submitted for the approval of the Governor General in Council, subject to the conditions of the company's undertaking of January 14, 1928.

The Minister, therefore, recommends, under Section 7, Chapter 140, Revised Statutes of Canada, 1927—the Navigable Waters Protection Act—the approval of the annexed set of two plans of certain reclamation work, and of the site thereof, according to the description attached, proposed to be made by the Creston Reclamation Company, Limited, in Unit No. 1 of the Kootenay River Flats, near Creston, B.C., such approval, however, to be subject to the conditions of the company's undertaking of January 14, 1928, quoted above.

The committee concur in the foregoing recommendation and submit the same for approval.

(Sgd.) E. J. LEMAIRE,
Clerk of the Privy Council.

Description of the lands proposed to be reclaimed in the Kootenay River Flats near Creston, British Columbia, in Unit No. 1, for the Creston Reclamation Company Limited.

The said lands are bounded on the south by the Goat river and the Kootenay river, said boundary being at or near the south boundary of sections 3, 4 and 5, township 8, Kootenay District, is bounded on the west by the Kootenay river, is bounded on the north by a line running easterly from the Kootenay river at or near the north limit of sections 32, 33 and 34, township 8 to the east limit of the Kootenay River Flats, is bounded on the east by the east limit of the Kootenay River Flats, said area containing approximately 8,600 acres as shown on the plans of Unit No. 1 of the Creston Reclamation Company Limited, for the reclamation of the Kootenay River Flats.

(Signed) A. L. McCULLOCH,
Consulting Engineer.

NELSON, B.C., May 16, 1927.

C

DEPARTMENT OF STATE

WASHINGTON, November 21, 1927.

To the Honorable the INTERNATIONAL JOINT COMMISSION,
WASHINGTON, D.C., and OTTAWA, CANADA.

SIRS: The Department of State received on November 3, 1927, from the Secretary of the United States Section of the Commission, a copy of the application of the Creston Reclamation Company, Limited, for permission to construct certain permanent works in and adjacent to the channel of the Kootenai river in the province of British Columbia, at Creston, and a copy of the notice given by the Commission that statements in response to that application must be filed with the Commission on or before November 25, 1927, and that a hearing will be held on the application at Nelson, British Columbia, November 29, 1927.

Experience in connection with streams of regimen similar to the Kootenai river has demonstrated that far-reaching and sometimes unanticipated disastrous effects often result on lands above when works are constructed restricting floodway channels in the lower reaches of a stream. These effects can be predicted in advance of construction only on the basis of exhaustive study of adequate hydrographic and topographic data.

In the short time intervening between the date on which the copies of the application and notice were received by the Department of State and the dates set for the filing of statements in response and for the hearing it is not possible for this Government to obtain the technical data necessary to enable it to formulate an opinion as to the probable effect which the works proposed by the Creston Reclamation Company, Limited, will have on waters on the United States side of the boundary and on interests in the United States.

This Government considers that it should have full opportunity to inform itself in regard to such effects by the collection and study of hydrographic and topographic data, and to present its views in respect thereof to the Commission for consideration in relation to the provisions of Articles IV and VIII of the Boundary Waters Treaty of 1909 before final action is taken by the Commission on the pending application of the Creston Reclamation Company, Limited.

It is therefore requested that an extension of time be granted for the filing of statements in response as provided for in rule 10 of the Rules of Procedure of the Commission and that no order of approval be issued by the Commission on the aforesaid application until such further hearings shall be had thereon under rule 20 of the Rules of Procedure as the interests of the parties affected may be found to require.

I suggest that proceedings on the pending application of the Creston Reclamation Company, Limited, subsequent to the hearing on November 29, 1927, be postponed for a period of one year, to afford time for the collection and study of the necessary hydrographic and topographic data.

Sincerely yours,

FRANK B. KELLOGG.

INTERNATIONAL JOINT COMMISSION

In the Matter of the Application of the Creston Reclamation Company, Limited, to the International Joint Commission for Permission to Construct Certain Permanent Works in and Adjacent to the Channel of the Kootenai River in the Province of British Columbia at Creston

MOTION ON BEHALF OF THE GOVERNMENT OF THE UNITED STATES FOR EXTENSION OF TIME FOR FILING STATEMENT IN RESPONSE AND FOR FURTHER HEARINGS

To the Honorable the International Joint Commission,

Washington, D.C., and Ottawa, Canada.

The Government of the United States respectfully submits in respect of the application of the Creston Reclamation Company, Limited, to the International Joint Commission for permission to construct certain permanent works in and adjacent to the channel of the Kootenai river in the province of British Columbia at Creston, British Columbia, the following:—

1. The Government of the United States is not informed otherwise than by the statement made by the applicant that the effect of the proposed works of British Columbia Reclamation Unit No. 1 on international waters will be merely nominal, or that the works will have no effect on low water. The applicant does not state the effect which the proposed works of British Columbia Unit No. 1 will have on flood water, and the Government of the United States is not informed in respect of the effect which those works will have on such waters.

2. The applicant states that British Columbia Unit No. 2 will be west of the Kootenai river and immediately west of Unit No. 1, but does not state the effect which Unit No. 2 will have on water at any stage and the Government of the United States is not informed as to the effect which the works of British Columbia Unit No. 2 will have on waters at any stage.

3. The applicant states that when the whole area of the Kootenai river flats on both sides of the international boundary has been reclaimed by the method proposed and the banks on both sides of the river are raised by the levees or dikes to a height of five feet above the 1916 flood as is proposed, and the flood waters are confined within the river banks, then in the occasional year that the flood would be higher than the natural river banks, and this flood is kept within the levees, the peak level of the flood in the river will be somewhat higher than in its natural state and the river surface also will assume a hydraulic gradient greater than the normal one, with an increased velocity of flow.

4. It is apparent that the works proposed by the Creston Reclamation Company, Limited, as British Columbia Unit No. 1 will, when the whole area of the Kootenai river flats on both sides of the international boundary has been reclaimed by the construction of levees or dikes, contribute to the combined effect resulting from such reclamation, on the level and velocity of the waters of the Kootenai river at the international boundary and in the United States. This is the case whether the effect of such reclamation be limited to raising the peak level of the water and increasing its velocity in times of flood as mentioned by the applicant, or whether also the natural level of the waters at the international boundary and in the United States will be raised at other times also. It is apparent that the works of British Columbia Unit No. 2 will also contribute to the increase in the height and velocity of the water of the Kootenai River resulting from the reclamation of the whole area. The Government of the United

States is not informed as to the degree to which the works of Unit No. 1 and Unit No. 2 will contribute severally or jointly to the effect of the reclamation of the whole area of the Kootenai flats on the level and velocity of the Kootenai River.

5. As the proposed works of British Columbia Unit No. 1 must, in view of the foregoing statements, particularly the statements in paragraphs 3 and 4, be regarded as tending to raise the natural level of the Kootenai River in the United States, the construction of any of such works clearly requires the approval of the International Joint Commission under Article IV of the Boundary Waters Treaty of 1909.

6. Experience in connection with streams of regimen similar to the Kootenai River has demonstrated that far-reaching and sometimes unanticipated disastrous effects are often caused on lands above when works are constructed restricting floodway channels in the lower reaches of a stream. These effects can be predicted in advance of construction only on the basis of exhaustive study of adequate hydrographic and topographic data. The Government of the United States believes that the proposed works of British Columbia Unit No. 1 and the works of British Columbia Unit No. 2 will cause injury to interests on the United States side of the boundary, or be a potential source of injury, and that therefore no order of approval of the works of either unit should be issued by the Commission which fails to take such interests into account and to require that suitable and adequate provision, approved by the Commission, be made for the protection and indemnity of all such interests pursuant to the provisions of Article VIII of the Boundary Waters Treaty.

7. The time elapsing between November 3, 1927, the date on which the Government of the United States received from the International Joint Commission a copy of the application of the Creston Reclamation Company, Limited, and November 29, 1927, the date set for the hearing at Nelson, British Columbia, is insufficient to enable the Government of the United States to make such investigations as are necessary to inform itself of the extent to which the proposed works of British Columbia Unit No. 1 will raise or tend to raise the natural level of the waters of the Kootenai River in the United States, and likewise the time is insufficient to enable the Government of the United States to ascertain what injury will be caused to interests on the United States side of the boundary by the construction and maintenance of such works, or to form an opinion as to the provision which should be made for the protection or indemnity of such interests pursuant to the provisions of Article VIII of the Boundary Waters Treaty.

8. Likewise the time is insufficient to enable the Government of the United States to inform itself concerning the effect which British Columbia Unit No. 2 will have on the level of the water in the United States and interests in the United States.

9. The Government of the United States submits that it should have time to collect adequate hydrographic and topographic data in relation to the questions set out in the foregoing paragraphs, to make a thorough study of such data, and submit its conclusions based thereon as to the effect of the works proposed by the Creston Reclamation Company, Limited, on the natural level of the waters of the Kootenai River in the United States and on all interests in the United States that may be injured by the construction and maintenance of such works, before the Commission holds final hearings or takes final action on the petition of the applicant.

10. The Government of the United States therefore respectfully requests that no order of approval be granted by the International Joint Commission on the pending application of the Creston Reclamation Company, Limited, until

the Government of the United States shall have had an opportunity through its engineers to make a careful investigation as to the extent to which the works proposed therein will raise or tend to raise the natural level of the waters of the Kootenai river in the United States and of all other aspects in which such works may affect the interests of the United States, its nationals and inhabitants, and to submit its views in respect thereof to the Commission. To this end the Government of the United States respectfully requests that the Commission grant an extension of time for the filing of statements in response to the aforesaid application to a date subsequent to November 25, 1927, and for such further hearings thereon as the interests of the parties affected may require.

11. The Government of the United States suggests that proceedings in the pending application of the Creston Reclamation Company, Limited, subsequent to the hearing on November 29, 1927, be postponed for a period of one year.

Respectfully submitted.

CHARLES M. BARNES,
Counsel for the Government of the United States.

WASHINGTON, D.C., November 23, 1927.

D

CRESTON RECLAMATION COMPANY

LIST OF EXHIBITS FILED AT HEARING AT NELSON, NOVEMBER 29, 1927

Plan of Unit No. 1—Reclamation of Kootenay River Flats, Creston, B.C. Filed by Andrew McCulloch on behalf of the Company.

Plan of Kootenay River Valley, Idaho. By J. C. Vernon, Bonners Ferry, Idaho. Filed by Mr. Vernon on behalf of the Company.

Letters passing between the Minister of Lands of British Columbia and the Creston Reclamation Company relative to the grant of land to the Company. Filed by Mr. C. B. Garland on behalf of the Company.

E

APPLICATION OF GEORGE LEONARD SALTER, TRUSTEE IN BANKRUPTCY OF KOOTENAY VALLEY POWER AND DEVELOPMENT COMPANY, LIMITED,

To THE INTERNATIONAL JOINT COMMISSION for permission to rehabilitate, reconstruct and repair certain permanent works in and adjacent to the channel of the Kootenay river and to construct and maintain certain permanent works in and adjacent to Boundary creek in the Kootenay District in the province of British Columbia.

Davis, Pugh, Davis, Hossie, Ralston & Lett,
Solicitors for the Applicant.

To The Honourable The International Joint Commission:

Application made by George Leonard Salter (hereinafter called "the Applicant") Trustee in Bankruptcy of the Kootenay Valley Power and Development Company Limited, for permission to rehabilitate, reconstruct and repair certain permanent works in and adjacent to the channel of the Kootenay River,

and to construct and maintain certain permanent works in and adjacent to the channel of Boundary creek in the Kootenay District, said works to be mainly upon Lot 774, Kootenay District, in the province of British Columbia, respectfully sheweth:—

I

STATUS OF THE APPLICANT

(1) The Applicant is a Chartered Accountant, a member of the firm of Shaw, Salter and Plummer, Chartered Accountants of 850 Hastings Street West, in the City of Vancouver, Province of British Columbia, and by resolution of the creditors of Kootenay Valley Power and Development Company Limited, held in the office of the Acting Official Receiver, Court House, Nelson, British Columbia, on Friday the 12th day of June, 1931, was duly elected, pursuant to the provisions of the Bankruptcy Act of the Dominion of Canada, R.S.C. 1927, Cap. 11, and amendments, Trustee in Bankruptcy of the Kootenay Valley Power and Development Company Limited.

(2) The Kootenay Valley Power and Development Company Limited (hereinafter called "the Kootenay Company") was a British Columbia Corporation, which was adjudged bankrupt on or about the 5th day of May, 1931.

II

HISTORY OF THE PROJECT

(3) On or about the 26th day of September, 1891, The Alberta and British Columbia Exploration Company Limited (hereinafter called "the British Company") a Company incorporated under the Laws of England entered into an arrangement with His Majesty the King as represented by the Government of the Province of British Columbia to reclaim certain lands, being a part of the lands known as "Kootenay Flats" situate between the South end of Kootenay Lake and the International Boundary, in which lands was included the land now known as lot 774, in respect of which this application is made.

(4) In 1892 in accordance with the arrangement made with the Government of British Columbia the British company commenced actual construction of dykes along the boundary of the Kootenay river and around and about that tract of land now known and described as lot 774, Kootenay District, containing 7,705 acres more or less and lying immediately north of and adjacent to the international boundary. The company actually completed at great expense a very considerable proportion of its construction program but the extraordinary high water of 1894 washed out portions of the dyke and flooded the area proposed to be reclaimed.

(5) By a grant from the Crown in right of the province of British Columbia made and given on or about the 18th day of November, 1894, the British company acquired title in fee to the said lot 774.

(6) The British company made further attempts to restore and complete its reclamation project during the years 1896, 1903, and 1904, and approximately in 1903 and 1904 completed dykes along the International boundary to protect the lands against the flood waters of Boundary creek, and possibly to divert its waters through Smith creek slough, and thence to the Kootenay river.

(7) It would appear that at this time the British company directly or indirectly owned or controlled the lands in the State of Idaho lying immediately south of and adjacent to the international boundary and between the boundary of the channel of the Kootenay river. These lands were subsequently alienated to one A. Klockmann or his predecessor in title.

(8) Subsequent to the operations of 1903-1904 at a time of which there is no available record, but apparently between 1904 and 1909 Boundary creek overflowed and cut a new channel along the dykes protecting the southern boundary of lot 774, that is to say, practically parallel to the international boundary, in which new channel it has ordinarily flowed.

(9) The British company and others with its permission carried on farming operations on lot 774 for a period of years, but subsequently flood waters damaged the dykes and flooded the lands, and the British company discontinued its farming operations but retained its title to the lands and continued to pay taxes thereon.

(10) The British company is still the registered owner in fee of the said lot 774.

(11) By an agreement dated the 2nd day of May, 1930, the British company agreed to sell to the Kootenay company the whole of the said lot 774 for the consideration and upon the terms more particularly set forth in the said agreement. The said agreement was entered into upon the understanding that the reclamation project in respect of lot 774 should be rehabilitated by the purchaser without expense to the British company.

(12) The Kootenay company by sundry agreements for sale agreed to re-sell almost the entire acreage contained in lot 774 to various farmers experienced in farming similar lands and all of whom were farmers from the United States. The Kootenay company had with the consent of the British company already commenced its operations of rehabilitation in 1929 and continued them in 1930. In 1930 these farmers entered upon their lands and began farming thereon.

(13) In 1930 the farms located on the south end of lot 774 adjacent to the International Boundary were flooded by reason of high water and insufficiency of the dykes, but a good crop was obtained from the farms located on the north end of the said lot.

(14) In 1931 a good crop was obtained from all farms located on the said land, but in the meantime owing to inadequate financing and unforeseen difficulties a receiving order in bankruptcy was made against the Kootenay company at the instance of certain of its creditors on or about the 5th day of May, 1931, and all rehabilitation of the reclamation work ceased.

(15) Between June 12, 1931, the date of the appointment of the applicant herein as trustee, and the spring of 1932 a considerable sum of money was expended by the trustee in the installation of a pumping system in an endeavour to render the land fit for seeding.

(16) In 1932 owing to the extraordinary high water and inadequate dykes the entire area was flooded and no crop was obtained.

III

THE APPLICANT PROPOSES BY THE REHABILITATION, CONSTRUCTION, RECONSTRUCTION AND REPAIR OF LEVEES AND DYKES TO RECLAIM LOT 774

(17) The applicant proposes to reclaim the whole of lot 774, which said lot is bounded on the east side by the Kootenay river and on the south side by the international boundary, along which south side now runs the said Boundary creek. The said lot 774 or a considerable portion thereof is flooded yearly by the flood waters of the Kootenay river and Boundary creek. The applicant proposes to make these lands commercially valuable for agricultural purposes.

(18) The reclamation project as planned will consist in rehabilitation, reconstruction and repair of certain levees or dykes around the lands to be

reclaimed which were constructed by the British company as hereinbefore stated, and in such places as are necessary to construct and maintain new dykes in accordance with the plans and specifications filed with this application. The said levees and dykes will be raised to an elevation well above flood level, as shown in the said plans and specifications.

(19) The applicant also proposes to re-open or re-construct the necessary drainage ditches on the said lands and to install the necessary pumping stations to pump out all storm water and seepage water from the said lands.

(20) The levees will be reconstructed substantially in accordance with the said plans and specifications and will in no way interfere with the natural flow of the Kootenay river, excepting in such years as the flood waters overflow the river bank.

(21) The levees or dykes along Boundary creek will be constructed along the north and south banks of the now existing channel of Boundary creek as shown on the said plan. Construction along the north bank will be entirely upon lot 774, and on the south bank will be upon property of the said A. Klockmann, situate in the State of Idaho, upon terms, negotiations in respect of which are now in progress.

(22) A contract has been negotiated with A. H. Green & Co. Limited, of Nelson, B.C., Engineers and Contractors, which contractor has agreed to complete the project substantially in accordance with the plans and specifications, upon terms agreed upon, subject always to the obtaining of an order of approval from this Honourable Commission.

(23) The Trustee in Bankruptcy has arranged for the financing of the project by cash contributions already agreed to be subscribed in an amount which the Trustee's engineer estimates is adequate for completion of the project on a sound and proper basis. A portion of this money has been subscribed and is available from the shareholders of the British company, a further portion from the personal funds of the applicant, but not in his capacity as trustee, and a further portion from the personal funds of A. H. Green, contractor, all of the said funds to be available only upon the approval of the project by this Honourable Commission. The trustee is prepared to enter upon and complete the project forthwith upon the making of the Order of Approval of this Honourable Commission.

IV

THE DESCRIPTION OF THE WORK AND PLANS SUBMITTED

(24) There is submitted with this application the following:—

(*a*) A detailed plan on tracing linen showing lot 774, Kootenay District and the northern portion of the lands of the said A. Klockmann, situate in the State of Idaho, adjacent to the said Boundary creek and the International Boundary, and further showing those portions of the old dykes to be rehabilitated and new dykes to be constructed.

(*b*) Specifications showing details for the reconstruction of the work necessary for completion of the project.

It will be noted that all dykes adjacent to the Kootenay river are now in existence and the applicant proposes only to repair the said existing dykes but not to construct any new dykes along the said river. New dykes will be constructed along portions of the bank of the area known and shown on the plan as the Big slough, and along portions of the north and south banks of Boundary creek.

V

EFFECT OF PROPOSED WORKS ON INTERNATIONAL WATERS

(25) The effect of the construction of the proposed works on the Kootenay river is merely nominal, it should have no effect whatever on low water, and during flood water the works are intended only to keep flood waters off the land reclaimed. The effect on Boundary creek of the proposed work is to confine Boundary creek to its now existing channel, that is to the channel in which it ordinarily flowed since the undetermined date hereinbefore referred to in paragraph (8), which said channel is not the original channel of Boundary creek according to maps prepared upon information obtained prior to 1909.

(26) During the periods of flood waters in the Kootenay river and Boundary creek the said waters will be confined within the dykes or within the dykes and natural river banks, as the case may be.

VI

CONSENTS

(27) The following consents are submitted and filed with this application:—

(*a*) Consent of the province of British Columbia as represented by a letter dated 19th September, 1932, from the Comptroller of Water Rights, Department of Lands, in the province of British Columbia, addressed to Messrs. Davis and Co. (Appendix 4.)

(*b*) Consent of The Alberta and British Columbia Exploration Company Limited dated the 22nd day of September, A.D. 1932. (Appendix 5.)

VII

PETITION

(28) Wherefore, this application is respectfully submitted for the consideration of this Honourable Commission and the applicant hereby applies to this Honourable Commission for the approval of the said works and plans thereof and the rehabilitation, construction, reconstruction, repair and maintenance of the said works substantially in accordance with the said plans and specifications, and for such order, ruling or decision authorizing and empowering the applicant to proceed with the said works as may in the opinion of this Honourable Commission be required by any Treaties or Statutes relating thereto, together with such proviso as may be deemed fitting in the premises.

All of which is respectfully submitted.

G. L. SALTER,
Trustee in Bankruptcy Kootenay Valley Power and Development Company Limited.

Davis, Pugh, Davis, Hossie, Ralston & Lett,
Solicitors for the Applicant.

Dated 23rd September, 1932.

(Appendices 1 and 2 being plans of the project are filed in the offices of the Commission.)

Appendix 3

SPECIFICATIONS

The contractor shall at the places designated by the plans accompanying these specifications and which will be staked out for him by the engineer, carry out the work called for in this contract and which shall include:—

(1) The reconstruction, repair and extension of the existing dyke along the south bank of Boundary creek.

(2) The reconstruction, repair and extension of the existing dyke along the north bank of Boundary creek.

(3) The reconstruction, repair and extension of the existing dyke along the east bank of Big slough.

(4) The reconstruction, repair and enlargement of the existing earth-fill dam at the head of Big slough.

(5) The reconstruction, and repair of the existing dyke along the west bank of the Kootenay river.

And the contractor shall perform all the labour necessary for the proper carrying out of this work and which shall include: clearing, excavation, digging of core-trench (where necessary), filling of core-trench, and dyking (placing of earth-fill), so that the dykes when completed shall stand at the desired elevation and be of the required dimensions and satisfactory to the engineer.

DETAILED SPECIFICATIONS

Clearing.

Clearing shall include the clearing of both the right of way for dyke and borrow-pit, as follows:—

Clearing of right of way.

Clearing of right of way shall include the removal of all stumps, standing timber, brush, roots, logs, rocks, surface-water, or other loose debris or material, which if left undisturbed would in the opinion of the engineer endanger the safety of the dykes built thereon.

Clearing of Borrow-pits.

Clearing of borrow-pits shall include the removal of all stumps, brush, roots, logs, loose rocks or other debris which if placed in a dyke would in the opinion of the engineer endanger its safety.

All material removed by the contractor from both the right of way and the borrow-pits shall be disposed of by him either by burning, or by dumping at some suitable place where it will not cause damage to person or property.

Material taken or removed from the right of way or borrow-pits shall not be piled on adjoining lands without the consent of the owner of the land having first been obtained, in writing.

Excavation.

Excavation shall include the removal by digging or other means of all surface or sub-soil which in the opinion of the engineer is necessary to obtain a good foundation so as to ensure the safety of the dykes built thereon; but shall not be taken to include the "digging of core-trench" which will be considered separately except when otherwise specified.

Digging of Core-Trench.

Digging of core-trench shall include the excavation of a trench below the base of the dyke in order to prevent seepage underneath and shall not be taken to include general excavation such as the removal of surface soil, etc.

Filling of Core-Trench.

Filling of core-trench shall include the placing of selected material in the trench after same has been excavated.

The material so placed shall be rolled or tamped if found necessary and shall be considered as being distinct from general earth-fill or dyking.

Dyking (placing of earth-fill).

Dyking shall include the placing of all earth-fill, above the surface of the prepared foundation or where a core-trench is necessary, above the finished surface of this core-trench.

Surface Elevation of Dykes.

The elevation of the crest of all dykes when finished and handed over by the contractor to the engineer shall not be lower than 24·00 feet as referred to Elevation 0·00 on the Creston Ferry gauge (as maintained and operated by the Dominion Water Power and Reclamation Service) on October 25, 1931.

Crest of Dykes.

The crest of all dykes when finished shall be horizontal, of even contour and of the width called for by the accompanying plans or as directed by the engineer.

Side Slopes.

The slopes on both sides of all dykes when finished shall be uniform and even and shall lie at such grades as may be called for by the plans accompanying these specifications; they shall be free from all loose rocks, humps or other irregularities and shall be so constructed that when completed they present a smooth and satisfactory appearance.

Centre Line of Dyke.

The contractor shall construct the dykes so that their centre-line when finished shall lie perpendicularly above the stakes set on the ground by the engineer; no deviation from the line as laid out on the ground will be allowed without the consent of the engineer having first of all been obtained.

Borrow-Pits (obtaining of earth for earth-fills).

The contractor shall obtain the necessary material (earth-fill) for the construction of the dykes from the waterside of the projected dyke wherever possible; he may however when conditions are such that material from the water-side is not available or when in the opinion of the engineer the cost to the contractor by doing so would be unduly increased, obtain the necessary material from the land-side of the dykes, but in no case will this procedure be allowed without the consent of the engineer having been obtained.

Borrow-pits when situated on the water-side of the dykes shall not approach within 15 feet of the finished toe of the dyke on that side, and where situated on the land-side of the dyke shall not approach within 20 feet of the finished toe of the dyke on that side.

All borrow-pits shall be as shallow as possible and shall have a depth of not more than 1 foot at the edge nearest the dyke; they shall slope uniformly away to the required depth at the far side and at grades which in the opinion of the engineer are safe and satisfactory; no deep holes as borrow-pits will be allowed.

Where borrow-pits on the land-side of the dykes are made continuous, berms shall be left at intervals as directed by the engineer.

Placing of Earth-Fill (Dykes and Core-Trench).

All earth-fill used in the construction of the dykes and the core-trench shall be placed in such a manner and by such method as will in the opinion of the engineer from time to time secure a satisfactory quality of work.

When the selection or grading of material available is required, this shall be undertaken by the contractor under the direction of the engineer.

Measurement of Work Done.

Before any work is accepted from the contractor a measurement of same shall be made by the engineer according to the standard methods adopted by the Engineering profession for such work and covering such operations as: clearing, excavation, trenching, and dyking.

Should a difference of opinion arise between the engineer and the contractor as to the amount of work actually done by him, the engineeer shall make a second measurement of the work done in the presence of the contractor.

But in all cases after this second measurement has been made the decision of the engineer as to the amount moved or cleared by the contractor shall be accepted by the contractor and regarded by him as final.

Miscellaneous Work.

All other work carried out by the contractor such as, driving of sheet-piling, installation of pipes, construction of intake and outlet structures, construction of flumes, pump houses, and including the installation of machinery, valves, fittings, etc., shall be to the satisfaction of the engineer and carried out in such manner and by such methods as may be directed by him from time to time.

Where material is supplied by the contractor it shall be of the quality specified by the engineer.

Where work or material is supplied by the contractor on a " cost plus " basis a certified statement of its actual cost shall be supplied by the contractor to the engineer.

Commencement, Prosecution and Completion of Work.

Work shall be commenced by the contractor within 14 days after the signing of the contract; it shall be prosecuted continuously and completed by the contractor to the satisfaction of the engineer and in accordance with these plans and specifications not later than the day of 19 .

DETAILS OF WORK TO BE PERFORMED BY THE CONTRACTOR

(1) Boundary Creek Dyke. (South Bank). Total length, 15,550 lin. ft.*

Comprising—		Approx. cu. yds. required
Construction of new dyke..	9,730 lin. ft.	36,700 cu. yds.
Repairing of old dyke..	5,620 lin. ft.	20,300 cu. yds.
Digging of core-trench..	1,500 lin. ft.	1,600 approx.
Clearing of right of way..	10 acres approx.	
Filling of core-trench..	1,500 lin ft.	1,600 approx.

(2) Boundary Creek Dyke (North Bank). Total length, 15,640 lin. ft.*

Comprising—		Approx. cu. yds. required
Construction of new dyke..	2,220 lin. ft.	11,920 cu. yds.
Repariing of old dyke..	13,620 lin. ft.	61,680 cu. yds.
Excavation..		5,200 cu. yds.
Digging of core-trench..	600 lin. ft.	660 approx.
Filling of core-trench..	600 lin. ft.	660 approx.
Clearing of right of way..	10 acres approx.	

(3) Big Slough Dyke (East Bank). Total length, 152,000 lin. ft.*

Comprising—		
Construction of new dyke..	10,600 lin. ft.	55,000 cu. yds.
Repairing of old dyke..	4,600 lin ft.	47,800 cu. yds.
Digging of core-trench..	1,000 lin. ft.	1,100 approx.
Filling of core-trench..	1,000 lin. ft.	1,100 approx.
Clearing of right of way..	10 acres approx.	

(4) Earth dam at Head of Big Slough. Total Length, 300 lin. ft.

Comprising—

Placing of earth fill..	9,000 cu. yds.
Digging of core-trench..	300 cu. yds.
Filling of core-trench..	300 cu. yds.

Sheet piling (Wakefield) 300 ft. by 16 ft.

Outlet pipe and drainage gate, 1—30″ dia. Corrugated Iron Pipe (115 lin. ft.) Concrete drainage-sump and Outlet Box.

(5) Kootenay River Dyke. Total Length, 11 miles.

Comprising—		
Repair of old dyke..	6,060 lin. ft.	12,000 cu. yds.
Clearing approx.	60 acres	

*(These figures are misprinted in the original application. They should be respectively 15,350, 15,840 and 15,200.)

Note.—It shall be distinctly understood by the contractor that while the above amounts are the estimated quantities which will be required to complete the work, these amounts may be reduced or increased from time to time by the engineer should he deem it necessary and that payment will be made to the contractor on the basis of actual yardage moved by the contractor at the completion of the work. Should the amount moved by the contractor under the direction of the engineer be greater than the amounts shown in the estimate, payment for the additional yardage moved will be made to the contractor at the same rates as before, and vice-versa. But in no case shall the contractor by virtue of an estimate given in these specifications alone, demand any set sum from the trustee.

It shall be further understood by the Contractor that the dykes will be constructed according to instructions given on the ground by the Engineer, who will inform the Contractor from time to time what dyke or dykes are to be built, according to how conditions may vary, such as Class "A" Dyke, Class "B" Dyke, Class "C" Dyke, Class "B" Dyke with Core-Trench. Class "C" Dyke with Core-Trench, etc. (see plans), but the engineer shall have the right to substitute a special type of dyke not shown, at any time, should the situation in his opinion demand it, and the contractor shall construct this dyke at the same rates per unit as those shown on the accompanying plan.

PAYMENT FOR WORK

Immediately upon receipt of his contract the contractor shall satisfy the trustee that he has on deposit in a chartered bank of Canada a sum of

money sufficient to enable him to successfully prosecute the work to a satisfactory conclusion, and in a manner so that when finished it shall be in accordance with these Specifications and the plans accompanying same.

Dated 23rd September, 1932.

G. L. SALTER,
Trustee in Bankruptcy Kootenay Valley Power and Development Company Limited.

Davis, Pugh, Davis, Hossie, Ralston & Lett,
Solicitors for the Applicant.

Appendix 4

THE GOVERNMENT OF THE PROVINCE OF BRITISH COLUMBIA

VICTORIA, B.C., September 19, 1932.

DEPARTMENT OF LANDS, WATER RIGHTS BRANCH

Messrs. Davis and Co.,
Barristers,
626 Pender St., W.,
Vancouver, B.C.

Attention Mr. Lett.

DEAR SIR,—

Please refer to File 095014

Re Kootenay Valley Power and Development Company.

I have your letter of September 16 relative to the reclamation project of the above company on Kootenay river near the international boundary.

The reclamation of land, as undertaken in this instance, does not come under the provisions of the Water Act except in so far as the natural course of any stream is altered. No approval of the general plans of such a scheme is required from, or can be given by, this branch.

In answer to your request for approval, I can only state that this branch has no objection to your undertaking as at present proposed.

Yours very truly,

J. C. MACDONALD,
Comptroller of Water Rights.

JCM:HH

I, DONALD GORDON MARSHALL, a notary public in and for the province of British Columbia, hereby certify that the above copy of letter dated September 19, 1932, from the Comptroller of Water Rights of the Province of British Columbia to Messrs. Davis & Co. is a true and faithful copy in words and figures of the original letter to me produced which after careful examination I attest.

In testimony whereof I have hereunto set my hand and Seal this 22nd day of September, 1932.

D. G. MARSHALL,
A Notary Public in and for the Province of British Columbia.

(Notarial Seal).

Appendix 5

IN THE MATTER OF THE APPLICATION OF GEORGE LEONARD SALTER, Trustee in Bankruptcy of Kootenay Valley Power and Development Company Limited, a Bankrupt, for permission to rehabilitate, reconstruct and repair certain permanent works in and adjacent to the Channel of the Kootenay River and to construct and maintain certain permanent works in and adjacent to Boundary Creek in the Kootenay District in the Province of British Columbia.

CONSENT

The Alberta and British Columbia Exploration Company Limited, a duly incorporated company being the registered owner of lot 774, Kootenay District, province of British Columbia hereby consents to the within application upon the basis of the plans and specifications filed therewith, and upon condition that the applicant shall obtain an order of approval from the International Joint Commission and without assuming any obligations, liability or responsibility to or towards any person or authority whatsoever by reason of the said application or any thing done pursuant to or consequent upon any order made by the said International Joint Commission.

As witness my hand and seal this 22nd day of September, A.D., 1932.

Signed, sealed and delivered by James Anderson, Attorney-in-Fact and authorized agent of The Alberta and British Columbia Exploration Company Limited in the presence of: W. P. LAWSON, 626 Pender St. W., Vancouver, B.C., Student-at-Law.	The Alberta and British Columbia Exploration Company Limited by its Attorney-in-Fact and authorized agent JAMES ANDERSON. (Seal)

I, DONALD GORDON MARSHALL, a notary public in and for the Province of British Columbia, hereby certify that the above copy of Consent dated September 22, 1932, from The Alberta and British Columbia Exploration Company Limited, is a true and faithful copy in words and figures of the original Consent to me produced which after careful examination I attest.

In testimony whereof I have hereunto set my hand and Seal this 22nd day of September, 1932.

D. G. MARSHALL

A Notary Public in and for the Province of British Columbia.

(Notarial Seal)

F

RESPONSE

By the West Kootenay Power and Light Company Limited to the application of George Leonard Salter, Trustee in Bankruptcy of the Kootenay Valley Power and Development Company Limited, for permission to rehabilitate, reconstruct and repair certain permanent works in and adjacent to Boundary Creek and Kootenay River, British Columbia.

To the Honourable, the International Joint Commission, Washington, D.C., and Ottawa, Canada.

The undersigned, solicitor for the West Kootenay Power and Light Company, Limited, with the consent of the Government of the Dominion of Canada first having been obtained, respectfully says in response to the application of George Leonard Salter, Trustee in Bankruptcy of the Kootenay Valley Power and Development Company Limited, as follows:—

1

That the West Kootenay Power and Light Company Limited, hereinafter referred to as the power company, is a corporation incorporated under a special act of the province of British Columbia, Canada, and as such is the owner of several water licences in respect of water flowing in Kootenay river, under the authority of which at certain points on said river the power company has developed and is operating power plants which depend for their operation upon a regular flow of water through Kootenay river below the point on Kootenay river with which the above-mentioned application is concerned.

2

The said power company has been to an expenditure of several millions of dollars in the erection of the aforesaid power plants and has been supplying and is now supplying the southern interior of British Columbia with electrical power, and all industries, cities and communities in the said district are dependent upon the supply of power from the said plants for their existence.

3

The said power plants were erected after a prolonged study of the minimum and maximum flow of Kootenay river, to produce the maximum power that could be produced at the respective power sites with the then average minimum flow of water in the river, and also with the view of the safety of said plants under the then known flood conditions of said river.

4

The power company hereby makes objection to the approval and construction of the proposed works set forth in the present application, because the construction of said works will have the effect of increasing the level of Kootenay lake and river during the flood season in the months of April, May and June of each year and of decreasing the minimum flow of Kootenay river during the winter months of November, December, January, February and March of each year, thereby placing upon the power plants of the power company a greater burden of water during flood season and reducing the amount of water that can be utilized for the production of power during the low-water season, thus seriously affecting the operations of the power company, and derogating from the privileges and benefits it is lawfully entitled to under the water licences which it legally owns on said river.

5

More specifically, the power company objects that the aforesaid application does not set forth sufficient engineering or hydraulic data from which a clear conception can be obtained of the scope or effect of the said works, in that the mere statement in the detailed specifications in Appendix 3 to the said application, that the elevation of the crest of all dykes when finished shall not be lower than 24 feet as referred to elevation 0·00 on the Creston ferry gauge, is not sufficient to determine the actual elevation of the crest of said dykes at said gauge nor at any other point along the Kootenay river between the said gauge and Boundary creek, along which the elevation must change suitably to the change in the hydraulic grade.

6

If the said levees and dykes are raised to an elevation well above flood level as stated in paragraph 18 of the said application, then there will necessarily be a great increase in the current of the Kootenay river adjacent to said levees and dykes during the flood period of said river in the months of April, May and June of each year, and an increase in the flood level of Kootenay lake and Kootenay river adjacent to the power plants of the power company.

7

A further effect of the construction of said levees and dykes in the manner aforesaid will be the depriving of Kootenay river of a large flood plain coextensive with the areas so included within said levees and dykes, thus depriving the river of this storage basin and decreasing the flow of water in the river in succeeding months after the flood level has passed, to the harm and detriment of the power company.

8

The construction of the said levees and dykes in the manner proposed likewise will increase the flood level of the river upstream from said works and tend to offset the reduction in the flood level of Kootenay river upstream from said works which the power company is endeavouring to effect through the proposals which the power company has made to the International Joint Commission in another application now pending before it.

9

The present applicant is wrong in stating, in paragraph 25 of his application, that the effect of the construction of his proposed works on Kootenay river is merely nominal and is wrong in stating in the same paragraph that the construction of said works would have no effect whatever on low water, for the reasons above stated.

10

The present applicant has failed to comply with the Navigable Waters Protection Act of the Dominion of Canada, Chapter 140 of the Revised Statutes of Canada, 1927, and particularly has failed to comply with Section 4 thereof, reading as follows:—

"No work shall be built or placed in, upon, over, under, through or across any navigable water unless the site thereof has been approved by the Governor in Council, nor unless such work is built, placed and maintained in accordance with plans and regulations approved or made by the Governor in Council."

11

That until the proposal of the power company now before the International Joint Commission for approval of works in the Kootenay river and for the right to store water in Kootenay lake is approved by your honourable Commission and the said works erected and brought into effect, the approval and erection of the works proposed to be erected by the present applicant will result in irreparable injury to the power company.

Wherefore the undersigned hereby requests your honourable Commission to wholly disapprove of the said works and plans set forth in the application of the said George Leonard Salter, and wholly disapprove of the rehabilitation, reconstruction, repair and maintenance of the said works, and refuse the said applicant authority and power to proceed with the said works.

All of which is respectfully submitted.

R. C. CROWE,
Solicitor for the West Kootenay Power and Light Company, Limited.

Dated at Trail, British Columbia, this 28th day of October, A.D. 1932.

G

LIST OF EXHIBITS FILED AT NELSON HEARING IN THE MATTER OF THE APPLICATION OF G. L. SALTER, TRUSTEE IN BANKRUPTCY OF KOOTENAY VALLEY POWER AND DEVELOPMENT COMPANY, LIMITED

Filed on Behalf of Canadian Government:

Exhibit No. 1.—Report entitled "Reclamation Farm Rehabilitation Project," compiled by T. M. Patterson. June 1, 1933.

Exhibit No. 2.—Table plan of Kootenay Reclamation Farm.

Exhibit No. 3.—Representations made on behalf of the Department of Indian Affairs of Canada.

Filed on Behalf of United States Government:

Exhibit No. 1.—Compilation of material submitted by Mr. J. A. Metzger, Department of State, Washington, D.C.

Exhibit No. 2.—Photostat copy of Map of Township No. 65 North of Range No. 2, West of Boise Meridian, Idaho. May 25, 1899. Filed by Mr. Metzger.

Exhibit No. 3.—Photostat copy of map entitled "Plan, Kootenay Valley Company Land, Kootenay River, West Kootenay, B.C., Township 7. December 11, 1891." Filed by Mr. Metzger.

Exhibit No. 4.—Report entitled "Effect of Dykes, Present and Prospective, on Increase of Flood Heights, of Kootenai River." By R. W. Davenport. June, 1933.

Filed on Behalf of Applicant Company:

Exhibit No. 1.—Key Plan, Kootenay Reclamation Farm (Plan No. 1, April, 1933).

Exhibit No. 2.—Certified copies of the minutes of the meeting of creditors of the Kootenay Valley Power and Development Company, held on June 12, 1931.

Exhibit No. 3.—Plan showing proposed dykes on Kootenay Reclamation Farm.

Exhibit No. 4.—Certified copy of special resolutions passed at meeting of the Company on June 12, 1928, confirmed at meeting on June 28, 1928, and approved by order of the Supreme Court of British Columbia on November 5th, 1928.

Exhibit No. 5.—Letter to Hon. Theodore Davie, Attorney General for British Columbia from G. A. Keefer, Inspecting Engineer for Alberta and British Columbia Exploration Company, Limited, August 10, 1894.

Exhibit No. 6.—Certificate of encumbrance showing state of title to District Lot 774, Kootenay, August 25th, 1933.

Exhibit No. 7.—Certified copy of letter from J. C. MacDonald, Comptroller of Water Rights for British Columbia, to Messrs Davis and Company, September 19th, 1932.

Exhibit No. 8.—Consent of Alberta and British Columbia Exploration Company Limited, September 22nd, 1932.

Exhibit No. 9.—Letter to International Joint Commission from A. Klockmann, Porthill, Idaho, dated September 28th, 1932.

Exhibit No. 10.—Letter from G. E. Crocker, Secretary, Kootenai Valley Reclamation Association, to Hon. John Bartlett, September 28th, 1932.

Exhibit No. 11.—Letter from Manager, Canadian Bank of Commerce, Creston, B.C., quoting telegrams sent in September, 1932, to International Joint Commission from Creston Board of Trade and Corporation of Village of Creston.

Exhibit No. 11A.—Profile showing increase in elevations, Kootenay River, with Kootenay Reclamation Farm dyked. 1933 (Plan No. 5A).

Exhibit No. 12.—Summary re effects of dyking Kootenay Reclamation Farm on adjoining lakes and water courses.

H

THE APPLICATION OF WEST KOOTENAY POWER AND LIGHT COMPANY, LIMITED, FOR APPROVAL OF THE CONSTRUCTION OF A STORAGE DAM AND COMPENSATING WORKS AND PLANS THEREFOR IN THE KOOTENAY RIVER AT OR NEAR GRANITE, BRITISH COLUMBIA

To the Honourable, the International Joint Commission, Ottawa, Canada, and Washington, D.C.

The undersigned, as Solicitor for the West Kootenay Power and Light Company, Limited (hereinafter called the company) respectfully represents:—

(1)

That the company is a corporation chartered by special act of the Province of British Columbia, Canada, being Chapter 63 of the Statutes of British Columbia, 1897, and amendments thereto, being found in Chapter 78 of the Statutes of British Columbia, 1911, and Chapter 76 of the Statutes of British Columbia, 1929, copies of which said act and said amending acts are set forth as Appendix 1 hereto, the purpose of the company as set forth in said act and amending acts being that of acquiring and holding water licences, and the developing and selling of power therefrom and doing all things necessary or incidental thereto, including the building of dams and compensating works for the storage of water in rivers, streams or lakes within a radius of one hundred and fifty (150) miles from the city of Rossland in said province.

(2)

That the company by said charter is authorized to purchase, acquire and hold land and real and personal property that may serve the purpose of its incorporation.

(3)

That the Company is in a position financially to carry out the proposed works hereinafter referred to.

(4)

That the company is the owner of several water licences granted by the province of British Columbia in respect of water flowing in the Kootenay river at several natural power sites below the site of the proposed storage dam at which sites the company has erected large power plants at a cost of several millions of dollars and which plants have an installed maximum capacity of one hundred and seventy thousand (170,000) horsepower and one of which plants requires ten thousand four hundred (10,400) cubic feet per second of water to flow continuously through said plant to enable it to produce continuously its installed horsepower and for which amount of water the company owns a licence from said Provincial Government.

(5)

That the Kootenay river has its source in eastern British Columbia, near the fifty-first parallel. It flows in a southerly direction into Montana, U.S.A., thence westerly to Bonners Ferry, Idaho, U.S.A., thence northerly and crosses into British Columbia at Port Hill, Idaho, and then discharges into Kootenay lake near Kootenay Landing, B.C., approximately twenty-eight (28) miles from the international boundary.

Kootenay lake has a length of sixty-six (66) miles with an average width of two to three miles and an area of one hundred and seventy (170) square miles. The West arm, which branches off from the main lake near Proctor, B.C., has a length of twenty (20) miles and emerges into a continuation of Kootenay river, through narrows at Grohman creek, about two (2) miles westerly from Nelson B.C. The twenty (20) mile stretch of river between Grohman creek and the confluence with the Columbia river has sufficient fall for other valuable power developments in addition to those above mentioned.

(6)

That the flow in the Kootenay river varies from average high water of one hundred and seven thousand (107,000) cubic feet per second in summer months to four thousand eight hundred (4,800) cubic feet per second in the winter. During November, December, January, February and March of each year the water flowing is frequently only sufficient to operate the two larger plants of the company at fifty per cent capacity, whereas during the high water period a very much larger amount of water than is required flows down the river. Maximum peak flow since the year 1900 occurred in 1903 when the flow in the Kootenay river below Nelson was approximately one hundred and fifty-one thousand (151,000) cubic feet per second and the level of the Kootenay lake at Nelson stood at 21·6 feet above the Nelson gauge zero mark. The highest water on record occurred in 1894 when the level at the same point was 28·2 feet above zero and about two hundred thousand (200,000) cubic feet per second was flowing in the river below Nelson.

Usually the annual rise in the water levels commences about the end of March and it reaches its flood peak generally between May 25 and July 10 and

on receding reaches the level of four and one-half feet (4·5 feet) above the zero mark on the gauge at Nelson, B.C., which zero mark is the average low water level based on the average low water flow for several years, about the end of August.

(7)

That at the time when the company first commenced its power development on the Kootenay river aforesaid very large acreages of land between Bonners Ferry in the State of Idaho, U.S.A., and thence northerly to the international boundary line at Port Hill, Idaho, were flooded by water from the Kootenay river during the months of each year constituting the high water period and as the river fell later in the season, acted as a reservoir for the said river, but in recent years very large portions of said acreages have been reclaimed by confining the Kootenay river to its normal low water channel between earthen dikes thus depriving the river of said reservoir with the result that in low water period the average flow of the river has been reduced and in high water period the average flow has been increased which in turn has resulted in depriving the company of a considerable portion of the former average minimum flow of the river and therefore reducing the amount of power which the company is able to develop in the low water periods.

(8)

That the company proposes, by the erection of a dam at or near Granite, B.C., and by the construction of compensatory works in the river immediately below and above said dam, to provide storage of approximately six (6) feet of water above the present low water mark in the Kootenay lake which will assure the company of having approximately ten thousand four hundred (10,400) cubic feet per second of water flowing through its power plants on Kootenay river, below Granite, B.C., during the low water period.

(9)

That the company proposes, when the said dam and compensatory works are completed, to partially close the sluice gates and run-aways in said dam when the water of Kootenay lake reaches a stage of approximately four and one-half feet (4·5 feet) above the average low water mark, at which level about twenty-three thousand seven hundred (23,700) cubic feet per second of water is flowing down the river below Nelson, and then allow the lake to slowly rise until it has reached the stage of six (6) feet above the said average low water mark which is the zero mark of the present gauge at the City of Nelson, B.C., thus providing a storage in Kootenay lake of approximately one hundred and thirteen thousand and seventy-five (113,075) acres.

The storage at no time would be increased above the said six (6) feet above the said average low water mark, but will be reduced throughout the months of November, December, January, February and March as required to maintain an outflow from Kootenay lake throughout the said period of ten thousand four hundred (10,400) cubic feet per second and the said storage in any event will be all drained out to the average low water mark at or about the end of March or when the waters of said river and lake commence to rise again as the result of the increase of water flowing into the said lake and river in the springtime.

(10)

That the construction of the said dam will not increase the natural elevation of the waters in Kootenay river or Kootenay lake at any stage above the proposed storage line.

(11)

That the compensatory work proposed to be done by the company in the vicinity of Grohman creek will permit of the discharge out of the lake of a larger quantity of water than under the present natural conditions and will, therefore, tend to lower the high water at all stages above the said storage line and the dam will be so constructed as to take care of a flow equal to that of the aforesaid 1894 flood.

(12)

That the aforesaid dam, as proposed by the company, will be built of reinforced concrete and steel on solid rock, provided with motor operated sluice gates supported between massive reinforced concrete piers and provided also with a spillway for free discharge over the crest. The company proposes in this work to do excavation in the river bed above and below the said dam to provide efficient discharge channels for the water before and after passing the dam.

(13)

That the effect of the aforesaid works on the level of the Kootenay river at the international boundary line and for some considerable distance beyond said line into the State of Idaho, will be to maintain the level of said river at a slightly higher stage during the low water period than it would naturally be in some years when the level would have otherwise receded to the average low water mark or below it. There have been in the past, however, frequent low water periods when the level of the river at the said boundary line would not have been affected in the least by said works and the necessary storage now sought by the company was then provided by nature. The company respectfully submits that this will not have any injurious effect on any interests in the United States or any State thereof. Furthermore, the said proposed works will tend to decrease the high water levels at said boundary line and beyond it and the company respectfully submits that this will be beneficial to all interests in the United States and particularly to the State of Idaho and is a benefit being sought by said interests.

(14)

That the following drawings, filed herewith, shall be read with, and form a part of, this application:—

Plan No. 1152. Showing location of proposed dam and area in which proposed works are to be constructed. This drawing shows plan of Kootenay river from outlet of Kootenay lake to a point about one-half mile below the dam site, also lots adjoining the dam site.

D-1 Granite dam proposed general arrangement.

D-2 Sluice gates for lake control.

D-3 Typical section through spillway.

D-4 Profile of river and lake from Granite, B.C., to Bonners Ferry, Idaho, U.S.A. This drawing indicates proposed maximum storage on Kootenay river and lake, also average low water line.

(15)

That the Consolidated Mining and Smelting Company of Canada, Limited, operating large smelters, zinc plants and refineries at the city of Trail, in the province of British Columbia, being dependent upon the company for an adequate supply of power and having committed itself to your Honourable

Commission in connection with another International problem, to erect large, extensive and costly plants in order to utilize the gases which it is at present emitting from its smelter stacks and which it is claimed are causing a nuisance in the State of Washington, U.S.A., and having represented to the company that it will require a large additional supply of electric power within a very short time in order to operate said plants, the company finds it necessary to obtain this power at as early a date as possible and has no means at its disposal to provide such power, within the time when it will be required by said company, other than through the storage project above set forth.

Wherefore the undersigned hereby applies to your Honourable Commission for the approval of the said plans for said dam and additional compensating works and of the said construction of said works substantially in accordance with said plans and for the right to store in Kootenay lake and river as aforesaid six (6) feet of water above the average low water mark of Kootenay lake.

Respectfully submitted,

R. C. CROWE,
Solicitor for West Kootenay Power and Light Company, Limited.

Dated at Ottawa, this 6th day of September, A.D. 1929.

Appendix I

1897. Chap. 63

West Kootenay Power and Light Company

CHAPTER 63

An Act to Incorporate the West Kootenay Power and Light Company, Limited

[8th May, 1897]

Preamble.

Whereas Oliver Durant, Patrick A. Largey, and Charles Rudolph Hosmer, have by their petition applied to be incorporated as a company, with power to supply power, light and heat by compressed air and electricity to the inhabitants, cities, towns, mines, smelters, railways and tramways in the District of West Kootenay, province of British Columbia, within a radius of fifty miles from the city of Rossland (which area is hereinafter referred to as "the said area"), and to construct and maintain buildings, erections, or other works, and to enter upon and expropriate lands for a site for power-houses, and other works, and to construct and maintain all works, buildings, pipes, poles, wires, appliances or conveniences necessary or proper for the generating and transmitting of compressed air and electricity as aforesaid; and also to construct, maintain and operate single or double lines of tramways and street railways in the cities and towns and throughout the said District of West Kootenay, and to erect poles, stretch wires, and maintain and operate telephone systems in the cities and towns and throughout the said district:

And whereas it is expedient to grant the prayer of such petition:

Therefore, Her Majesty, by and with the advice and consent of the Legislative Assembly of the Province of British Columbia, enacts as follows:—

Incorporation. 1. Oliver Durant, Patrick A. Largey, Charles Rudolph Hosmer, and such other person or persons, corporation or corporations, as shall in pursuance of this Act become shareholders in the company, are hereby constituted a body corporate by the name of the "West Kootenay Power and Light Company, Limited," and hereinafter called "the Company."

Capital stock. 2. The capital stock of the company shall be one million dollars, divided into ten thousand shares of one hundred dollars each.

Increase of. 3. The capital stock of the company may be increased from time to time to any amount, if such increase be sanctioned by a majority vote, in person or by proxy, of the shareholders who hold at least two-thirds of the subscribed stock of the company, at a meeting expressly called by the directors for that purpose, by a notice stating the object of such meeting and the amount of the proposed increase. A copy of such notice shall be sent to each shareholder by mail, post paid, to the last known address of such shareholder, at least thirty days before such meeting, and published in the British Columbia Gazette for at least two weeks before the date of such meeting, and the proceedings of such meeting shall be entered in the minutes of the proceedings of the Company, and thereupon the capital stock may be increased to the amount sanctioned by such vote.

New shares, preferential or otherwise. 4. The new shares shall be issued upon such terms and conditions and with such rights and privileges as the directors shall determine, and in particular such shares may be issued with a preferential or qualified right to dividends and in the distribution of assets of the company, provided that the consent of the majority in value of the shareholders of the company shall be first had and obtained.

Head Office. 5. The head office of the company shall be at the city of Rossland, or at such other place in the province of British Columbia as may be thereafter determined upon by the directors of the company.

Provisional Directors. 6. The persons named in the first section of this Act shall be the provisional directors of the company and the said Provisional Directors (of whom two shall form a quorum) shall hold office as such until the first election of Directors under this Act, and may forthwith open books, and allot shares, and receive payment on account of the shares allotted, enter into contracts on behalf of the Company, and cause surveys and estimates to be made, and any one or more of them may authorize and empower any shareholder of the Company by proxy to act for one or more of them at any meeting of such Directors.

General meeting for election of Directors. 7. The Provisional Directors shall, within three months after this Act comes into operation, call a general meeting of the shareholders at such time or place as they may think proper, by giving at least fourteen (14) days' notice thereof by letter addressed to each shareholder of the time and place of such meeting, at which meeting the whole of the Provisional Directors shall retire from office, and a board of not less than three nor more than seven Directors, as may be from time to time determined by the shareholders by resolution, shall be elected, and the Directors so elected shall hold office until the annual general meeting of the company next after their respective elections.

8. The directors shall have full power to pass by-laws, rules, regulations or resolutions for the management of the company, and alter, amend or repeal the same as they deem necessary; the acquisition, management or disposition of its stock, subject to the approval, in general meeting assembled, of a majority in value of the shareholders; the declaration and payment of dividends out of the profits of the Company; the form and issuing of share certificates and the transfer of shares; the appointment and remuneration and removal of all officers, agents, clerks, workmen and servants of the Company; the rules to be observed by the officers and servants of the Company and all persons using the power appliances or property of the Company; and may also make rules and regulations for the maintenance of the Company's undertakings; the rates for compressed air electricity supplied and rents for telephones, compressed air and electrical appliances let for hire, and for fixing the time or times when and the places where the same shall be payable, and for the collection of tolls for freight or ores, and fares for the carriage of passengers. **Directors' powers.**

ELECTRICITY AND COMPRESSED AIR

9. The Company is hereby authorized and empowered to erect, construct, operate and maintain compressed air and electric works, power houses, generating plant and such other appliances and conveniences as are necessary and proper for the generating of compressed air and electricity, and for transmitting the same to any part of the said area to be used as a motive power for the tramways by this Act authorized, or other works of the company, or to be supplied by the company as a motive power for hauling, propelling, pumping, lighting, heating, smelting, crushing, milling or drilling, or any other operations of any nature or kind whatever for which compressed air or electricity may be used, supplied, applied or required. And for any of the above purposes the Company is hereby authorized and empowered by its servants, agents, contractors and workmen from time to time to make and erect such compressed air and electric works, and to sink, lay, place, fit, maintain and repair such wires, accumulators, storage batteries, transformers, cables, mains, pipes, switches, connections, branches, motors, dynamos, engines, machines, cuts, drains, water-courses, buildings and other devices, and to erect and place any electric line, cable, main, wire, pipe or other compressed air and electric apparatus above or below ground, along, over or across any street, bridge or highway, or any line or lines of railway, tramway or street railway in said area, and to erect poles or pipes for the purpose of placing the same in such manner as the Company shall think fit, necessary or proper for the purpose of carrying out the operations of the Company in respect of and incidental to the making, generating or supplying of compressed air and electricity. **Electrical and compressed air works, etc.**

10. It shall be lawful for the Company to contract with any person, body corporate or politic, for supplying compressed air and electricity to any such person, body corporate or politic, or to any streets, ways, lanes, passages, tramways, mines, smelters, mills, manufactories, shops, warehouses, public or private houses, buildings and places, and for such purposes the Company may, from time to time, lay down, carry, fit up, connect and furnish any accumulator, **Contracting for supply to persons, corporations, etc.**

storage battery, cable, wire, pipe, switch, connection, branch, burner, lamp, meter, transformer or other apparatus for or in connection with any compressed air or electric main, pipe, lead or cable which for such purposes may be required, and to let any such apparatus for hire for such sum as may be agreed upon.

Company's appointee may enter premises for certain purposes.

11. Any person appointed by the company may, at all reasonable times, enter any premises to which compressed air or electricity is or has been supplied by the company, in order to inspect the lines, accumulators, fittings, works and apparatus for the supply or application of compressed air and electricity belonging to the company, and therein and for the purpose of ascertaining the quantity of compressed air and electricity consumed or supplied, or where a supply of compressed air or electricity is no longer required, or where the company is authorized to take away or cut off the supply of compressed air or electricity from any premises for the purposes of removing any pipes, wires, accumulators, transformers, motors, distribution boards, meters, fittings, lamps, works, or other apparatus belonging to the company.

Non-liability of Company's apparatus to seizure by distress, etc.

12. Where any electric lines, accumulators, transformers, motors, meters, generators, distribution boards, lamps, pipes, fittings, works or apparatus belonging to the company are placed in or upon any premises not being in possession of the company for the purpose of supplying compressed air or electricity, such electric lines, accumulators, transformers, motors, meters, generators, distribution boards, lamps, pipes, fittings, works or apparatus, shall not be subject to distress for rent for the premises where the same may be, nor be taken in execution, under any process of law or equity, against the person in whose possession the same may be.

Cutting off supply for non-payment of dues.

13. If any person neglect to pay any charge for compressed air or electricity, or any other sum due from him to the company, either in respect of the supply of compressed air or electricity to such person, or in respect of the rent reserved by the company for the use of electric lines, meters, accumulators, transformers, motors, distribution boards, lamps, pipes, fittings, works or apparatus lent or supplied for hire to such persons, the company may cut or disconnect any pipe or electric line or other work through which compressed air or electricity may be supplied, and remove such articles and works above mentioned as were lent for hire to such person.

Use of power developed by others.

14. The company is hereby authorized and empowered to acquire, by purchase or otherwise, the right to use, and to use and employ, power already developed by others, at any point or points, and whether the same be in the form of electrical power, compressed air, or otherwise.

Entry on adjoining lands to clear right of way.

15. The company may also, by its workmen, servants, or agents, enter into and upon any lands adjoining the works of the company, or any line or lines of pipe, fluming or wire laid or erected by the company as a means of transmitting power for or in connection with any of the purposes referred to in this Act, and clear the said lands of timber and underwood to such width on each side of the said works, or such line or lines of pipe, fluming, or wire, as aforesaid, as the company may deem necessary for the proper protection of the same, subject, however, to making compensation for such clearing in manner hereinafter mentioned.

TRAMWAYS

16. The company is hereby authorized and empowered to construct, maintain, complete and operate a line or lines of single or double track street railway or tramway, with all necessary switches, side tracks and turn outs, and all other requisite appliances in connection therewith, for the passage of cars, carriages and other vehicles adapted to the same, upon and along any street, highway, or bridge within any municipality in the said area, subject to the consent of the council of such municipality, and upon and along any land, street, bridge, or highway, in and throughout the said district, and to transport and carry passengers, freight and ores upon the same, by electricity, or such other motive power as the company may deem expedient; and also to erect, maintain and construct all necessary works, buildings, pipes, poles, wires and appliances or conveniences necessary or proper for the use of the said street railway or tramway, or in connection therewith. Tramway.

17. The several provisions of the "Tramway Company Incorporation Act, 1895," and any Act passed in substitution therefor, or any amendment thereto, save and except sections 1, 2, 3, 4, 5, 6, 11, 12 and 13, shall be incorporated into and shall be deemed to be part of this Act, and the company shall have all the rights and privileges conferred, and in all things not herein provided for, shall conform to and be governed by the said "Tramway Company Incorporation Act, 1895," save in so far as the said "Tramway Company Incorporation Act, 1895," is modified or altered by this Act. Application "Tramway Incorporation Act, 1895."

18. The company shall publish for the period of one month in the British Columbia Gazette, and in one newspaper published in the District of West Kootenay, a notice stating the points between which it is proposed to build such tramway, and the general route of the same. The notice shall be signed by the company. Publication of intended route of tramway.

19. Any person through whose lands the line is proposed to be run, or any railway or tramway company, whether proposed or in operation, whose line would be paralleled by the proposed tramway, may, within two months after the date of the first publication of the notice aforesaid in the British Columbia Gazette, give notice in writing, stating that he objects to the construction of the said tramway with the grounds of objections, to the Registrar of Joint Stock Companies, who shall notify the company, and the matter shall then be referred to the Lieutenant-Governor in Council, who shall, after hearing evidence, upon oath if required, determine the same, and if he thinks it expedient, may sanction the construction of the tramway upon such conditions, if any, as he sees fit to impose. A certified copy of the Order in Council, determining the application, shall be transmitted to the Registrar of Joint Stock Companies. Persons through whose lands line is intended to be run may object, etc. Order in Council.

20. The company shall, after the publication of said notice, apply to the Registrar of Joint Stock Companies for permission to construct the said tramway, and if no notice of objections has been received by the Registrar of Joint Stock Companies within the time aforesaid, or if notice has been received by him, then, on receipt of a certified copy of an Order in Council sanctioning the construction of the said tramway, the Registrar shall grant permission for the construction of the said tramway. Permission to commence construction.

Time for commencement of construction.

21. The company shall commence the actual construction of the said tramway line within a period of two months from the date of said permission, unless on good cause shown the Lieutenant-Governor in Council shall extend the said period, and shall continue and prosecute the construction of the said tramway until the same is completed: Provided always, that upon the company failing to comply with the provisions of this section, the Lieutenant-Governor in Council may revoke the permission granted.

TELEPHONE

Telephone.

22. The company may construct, erect and maintain a line or lines of telephone along the sides of and across or under any highways, streets, bridges or any line or lines of railway, tramway or street railway in any municipality in the said District of the West Kootenay, or along the sides of and across or under any highways, streets, bridges or any such place in and throughout the said district, and the company may, by its servants, workmen or agents, enter upon any highway, street, bridge or such other places as aforesaid for the purpose of erecting and maintaining its line or lines of telephone along the sides of or across or under the same, and may construct, erect and maintain such and so many poles and all other works and devices as the company deems necessary for making, completing, supporting, using, working and maintaining the system of communication by telephone, and may stretch wires thereon.

Tariff of charges.

23. The company may, by its by-laws fix, from time to time, a tariff of charges for the connection and the use of its wires and telephones and the transmission of messages, and shall have full power to collect, sue for and recover the charges to which it becomes entitled.

GENERAL PROVISIONS

General power to acquire and deal with street railways, tramways and telephone systems.

24. The company may purchase, lease or otherwise acquire for any term of years any street railway, tramway or telephone systems, established or to be established in British Columbia, connected or to be connected with the line or lines which this company is authorized to construct, or may purchase, lease or otherwise acquire for any term of years the right of any company to construct and maintain any street railways, tramway or telephone systems, and may amalgamate with or lease its line or lines, or any portion or portions thereof, to any company possessing, as proprietor or otherwise, any lines of street railway, tramways or telegraph or telephone communication connecting or to be connected with the company's line or lines, and the company may enter into any agreement with any company possessing, as proprietor or otherwise, any line or lines of street railway, tramway or telephone or telegraph systems upon any such terms as may be deemed expedient and advisable, and may become a shareholder in any such company.

Powers of amalgamation, consolidation, leasing, sale, etc.

25. The company may unite, amalgamate and consolidate its stock, property, business and franchises with any other company incorporated for all or any of the purposes which this company is formed to carry on, and may sell, lease or otherwise dispose of any or all of its franchises, powers, rights, privileges and undertakings to any other company, person or persons, and may enter into working engagements with, or may enter into a lease of or take and hold

shares in, or acquire the right to work the line or lines of any other company which has been or may hereafter be empowered to carry on undertakings altogether or in any part similar to those of this company.

Laying of pipes, wires, etc., on streets, roads, bridges, etc.

26. The company may, subject to the consent of the Chief Commissioner of Lands and Works, or of the proper authority having control of the streets, roads, highways and bridges, open and break up the soil and pavement, and any sewers, drains or tunnels within or under such streets, roads, highways and bridges, and lay down and place within the said limits its tracks, pipes, wires and poles, and from time to time repair, alter and remove the same, and for the purposes aforesaid, may remove and raise all earth and materials in and under such streets, highways and bridges, and do all other acts which the company shall, from time to time, deem necessary for the purpose of running its line or lines of street railway and tramways and supplying compressed air and electricity and maintaining a telephone service as hereinbefore more fully specified, doing as little damage as may be in the execution of the powers hereby granted, and making compensation for any damage which may be done in the execution of such power.

Repairing, etc., of roads.

27. When the company opens or breaks up the roadway or pavement of any highway, street or bridge, or any sewer, drain or tunnel, it shall, with all convenient speed, complete the work for which the same shall be broken up, and shall fill in the ground, reinstate and make good the road or pavement, or the sewer, drain or tunnel so opened or broken up, and carry away the rubbish occasioned thereby; and shall at all times, whilst any such road or pavement shall be open or broken up, cause the same to be fenced and guarded, and shall cause a light, sufficient for the warning of passengers, to be set up and maintained against or near such road or pavement where the same shall be open or broken up, every night during which the same shall be continued open or broken up, and shall keep the road or pavement which has been so broken up, in good repair for one month after replacing the same.

General power to lease, hold lands, electrical works, etc.

28. The company may purchase, acquire, or lease and hold, and may sell, dispose of, or surrender any lands, buildings or tenements, and may, for all or any of the said purposes, purchase or lease for any term of years any compressed air, electrical works, street railway, tramway or telephone systems established or to be established within the said District of West Kootenay, and may enter into working arrangements with, or may enter into a lease of, or acquire the right to work and operate any such systems, or to use the property and plant of such systems.

Expropriation powers.

29. It shall be lawful for the company, its servants, agents or workmen, from time to time, and at all times hereafter, as they shall see fit, and they are hereby authorized and empowered to enter into and upon the land of any person or persons, bodies politic and corporate, set out and ascertain, take, expropriate, hold and enjoy such part or parts thereof as it may require for the purposes of the undertakings by this Act authorized, or any one or more of them, and to contract with the owners or occupiers of lands for the purchase thereof, or any part thereof, or of any right, easement or privilege that may be required for the purposes of the company, and for the

right to take all timber, stone, gravel, sand, and other materials, from the same for the use and construction of the said works of the company.

Arbitrations.

30. In case of disagreement between the company and the owner or owners of the said lands, or of any such privilege or privileges, right or rights as aforesaid, respecting the amount of purchase money or value thereof, or as to the amount of damages arising through the disturbance of the surface of any of the said lands, in the course or by reason of the construction of any dams, reservoirs, raceways or flumes, or the laying of any pipe, the same shall be decided by three arbitrators, to be appointed as hereinafter mentioned, namely: The company shall appoint one, the owner or owners shall appoint another, and such two arbitrators shall, after their appointment, appoint a third arbitrator.

Award.

31. The arbitrators to be appointed as hereinbefore mentioned shall award, determine and adjudge, and order, whether any, and if so, what sum or sums of money the company shall pay to any person or persons in respect of any of the matters so referred, and the award of the majority shall be final.

"Arbitration Act, 1893."

32. The several provisions of the "Arbitration Act, 1893," or of any act passed in substitution thereof, shall be incorporated into and deemed to be part of this Act, except in so far as the same may be repugnant to or inconsistent with the express enactment hereof.

Tender of amount awarded.

33. Upon payment or tender of the amount so awarded, the owners or occupiers of the lands, rights or privileges aforesaid, shall, at the cost and expense of the company, make, do and execute all such acts, deeds, matters and things necessary on the part of such owners or occupiers, or any of them, to vest a complete and perfect title to the said lands, rights or privileges in the said company and its successors.

Limitation of time for commencement of actions against the Company.

34. All actions or suits for indemnity for any damage or injury sustained by reason of the works or operations of the company, shall be commenced within twelve months next after the time when such supposed injury is sustained, or if there is continuance of damage, within twelve months next after the doing or committing of such damage ceases, and not afterwards, and the defendant may plead the general issue, and give this Act and the special matter in evidence at any trial to be had thereupon, and may prove that the same was done in pursuance of and by authority of this Act.

Liability of share holders.

35. The liability of the shareholders shall be limited to the amount unpaid on their shares in accordance with, and as if the company had been incorporated under Part First of the "Companies' Act," and the Act of the Imperial Parliament passed in the twenty-fifth and twenty-sixth years of the reign of Her Majesty, Queen Victoria, Chapter 89, intituled the "Companies' Act, 1862," as herein modified; and the company shall have all the rights and privileges conferred, and in all things not hereinbefore provided for, shall conform to and be governed by the said Part First of the "Companies' Act," and the "Companies' Act, 1862," save in so far as the said Part First of the "Companies' Act," and the "Companies' Act, 1862," is modified or altered by this Act.

36. The directors of the company may, from time to time, borrow, for the purposes of the company, such sum or sums of money as they may consider expedient, and may issue bonds or debentures of the company, in sums not less than one hundred dollars each, and on such terms and credit as they may think proper, and may pledge or mortgage all the property, tools, income and uncalled capital of the company, or any part thereof, for the payment of the moneys so raised or borrowed, and the interest thereon: Provided, always, that before any such bonds or debentures are issued, the consent of three-fourths in value of the shareholders of the company shall be first had and obtained at a special meeting to be called and held for that purpose. Directors' borrowing powers.

37. The company may purchase, take on lease, or in exchange, hire, or otherwise acquire, any real and personal property, and any water rights, mill sites, or other privileges which the company may think necessary or convenient for the purposes of its business. Power to purchase, lease, exchange real and personal estate, etc.

38. The powers and privileges conferred by this Act, and the provisions hereof, are hereby declared to be granted, subject to the rights of the Crown, and also subject to any future legislation regarding the subject-matter of this Act, or of the powers and privileges hereby conferred, which the Legislature may see fit to adopt; and this Act is passed upon the express condition that the Lieutenant-Governor in Council may, from time to time, impose and reserve to the Crown, in the right of the Province, such rents, royalties, tolls and charges in respect of the waters, or of the lands of the Crown (if any), rights and privileges, which shall be set out, appropriated, or enjoyed by the company, or are conferred by this Act, as by the Lieutenant-Governor in Council shall be deemed to be just and proper; and may likewise make and pass such regulations and rules as may be deemed necessary and advisable, for the collection and enforcement of such rents, royalties, tolls and charges, or of any of them, but so that no increase in the amount of any such rents, royalties etc., fixed by any such Order in Council, shall be made within the space of three years from the passage of the Order in Council fixing the same. Rights hereby granted, subject to rights of the Crown and to future legislation, and rents, etc., to be imposed by Lieutenant-Governor.

39. The company shall begin the construction of its lines for conveying electricity within six months from the passage of this Act, and shall have the same completed so far as to enable it to supply power in the vicinity of Rossland, within two years from the passage of this Act. Time for construction of electric lines.

40. This Act may be cited as the "West Kootenay Power and Light Company, Limited, Act, 1897." Short title.

1911 Chap. 78

West Kootenay Power and Light Company (Amendment)

Chapter 78

An Act to Amend the Act to Incorporate The West Kootenay Power and Light Company, Limited

[1st March, 1911]

Preamble.

Whereas The West Kootenay Power and Light Company, Limited, were incorporated by Act of the Legislative Assembly of the Province of British Columbia, being chapter 63 of the Statutes of the year 1897, for the purposes and with the objects therein expressed:—

And whereas The West Kootenay Power and Light Company, Limited, have by their petition applied to have their Act of Incorporation amended so as to ratify a guarantee already given by them of certain bonds of Cascade Water Power and Light Company, Limited, and to enable them to guarantee the bonds or debentures of any other company;

And whereas it is expedient to grant the prayer of such petition;

Therefore, His Majesty, by and with the advice and consent of the Legislative Assembly of the Province of British Columbia, enacts as follows:—

Guarantee bonds Cascade Water Power and Light Co.

1. The guarantee of The West Kootenay Power and Light Company Limited, for securing the payment of the principal moneys and interest and sinking fund of those certain bonds all dated the first day of May, 1907, issued by Cascade Water Power and Light Company, Limited, for securing a total sum of three hundred thousand dollars ($300,000) and interest, such bonds being numbered from 1 to 600 inclusive, and payable to the bearer thereof, or if the same be registered, to the registered holder thereof, on the first day of May, 1940, for the sum of five hundred dollars ($500) each, with interest at four and one-half per cent ($4\frac{1}{2}\%$) per annum, payable semi-annually on the first days of May and November in each year, is hereby declared to be a good and valid guarantee, and binding upon The West Kootenay Power and Light Company, Limited.

Guarantee bonds other companies.

2. The West Kootenay Power and Light Company, Limited, shall, subject to the consent of the Lieutenant-Governor in Council, have full power from time to time to guarantee the principal moneys and interest and sinking fund of any bonds issued by any company having objects wholly or in part similar to those of The West Kootenay Power and Light Company, Limited.

Short title.

3. This Act may be cited as "The West Kootenay Power and Light Company, Limited, Amendment Act, 1911."

As reported by the Private Bills Committee on the 14th day of March, 1929. W. H. Langley, C.L.A.

Mr. Davie.

BILL

No. 53.] [1929.

An Act to amend the "West Kootenay Power and Light Company, Limited, Act, 1897." 1897, c. 63; 1911, c. 78.

Whereas the West Kootenay Power and Light Company, Limited, has by its petition applied to have its Act of Incorporation, being chapter 63 of the Statutes of 1897, amended to authorize it to acquire the right to generate electric power for transmission to and sale in places outside the area contained within a radius of fifty miles from the city of Rossland; and to authorize it to transmit electric power generated at its existing plants at or near Bonnington Falls, in the District of West Kootenay, to any place within an extended area comprising the city of Rossland and all lands within the province situate within a distance of one hundred and fifty miles from the city of Rossland; and also to authorize it to generate electric power at any other place or places within the said extended area where electric power can be advantageously generated, and to transmit the same to any place within the said extended area: Preamble.

And whereas it is expedient to grant the prayer of the said petition, and to amend the said Act of Incorporation as hereinafter provided:—

Therefore, His, Majesty, by and with the advice and consent of the Legislative Assembly of the Province of British Columbia, enacts as follows:—

1. "The West Kootenay Power and Light Company, Limited, Act, 1897," being chapter 63 of the Statutes of 1897, is amended by striking out the words "(which area is hereinafter referred to as 'the said area')" in the seventh line of the preamble. Amends Preamble.

2. Said chapter 63 is amended by inserting therein after section 8 the following heading and section:— Enacts s. 8A.

"INTERPRETATION

"8A. In the following sections of this Act the expression 'said area' shall mean the area which comprises the city of Rossland and all lands within the province situate within a distance of one hundred and fifty miles from the city of Rossland."

3. Section 16 of said chapter 63 is amended by striking out the word "district" in the ninth line thereof, and substituting therefor the word "area". Amends s. 16.

4. Section 22 of said chapter 63 is amended by striking out the words "District of West Kootenay" in the fourth line, and substituting therefor the word "area"; and by striking out the word "district" in the sixth line, and substituting therefor the word "area". Amends s. 22.

5. Section 28 of said chapter 63 is amended by striking out the words "District of West Kootenay" in the sixth line, and substituting therefor the word "area". Amends s. 28.

Power to acqure licences under "Water Act."

6. The West Kootenay Power and Light Company, Limited, may apply for, acquire, and hold, under the "Water Act," authorizations, certificates of approval, and Class C and other licences authorizing the diversion and use of water for the generation of electrical energy and the sale of the electric energy so generated anywhere within the area which comprises the city of Rossland and all lands within the province situate within a distance of one hundred and fifty miles from the city of Rossland; and upon acquiring any such authorization, certificates, or licence, the said company shall have power to carry out the obligations imposed and to exercise the rights, powers, and privileges granted thereunder.

Power to acqure lands and easements.

7. The West Kootenay Power and Light Company, Limited, may acquire and hold lands and easements for the construction and operation of the works authorized under any licence which it now holds or which it may acquire.

Short title.

8. This Act may be cited as the "West Kootenay Power and Light Company, Limited, Act, 1897, Amendment Act, 1929."

I

STATEMENT RELATIVE TO APPLICATION OF WEST KOOTENAY POWER AND LIGHT COMPANY FOR PERMIT TO REGULATE FLOW FROM KOOTENAI LAKE, WITH SPECIAL REFERENCE TO THE EFFECTS IN IDAHO

Prepared by U. S. Geological Survey, 1929

To the Honorable, the International Joint Commission, Washington, D.C. and Ottawa, Canada.

The United States Geological Survey respectfully presents the following information and discussion relative to the application of the West Kootenay Power and Light Company, Limited, for approval of the construction of a storage dam and compensating works in the Kootenai river at or near Granite, B.C., and of the plans therefor.

SUMMARY

The West Kootenay Power and Light Company, a Canadian corporation, has made application to the International Joint Commission under the provisions of the treaty between the United States and Great Britain, signed January 11, 1909, for approval of the construction of a dam on the Kootenai river in British Columbia, the effect of which is to raise the natural level of waters on the United States side of the boundary in the State of Idaho. Such effect will be injurious to a large area of flat, overflow lands adjoining the river in the State of Idaho, because it will raise the water table under these lands in such manner as to increase the difficulty of draining them so as to fit them for agricultural production. It is believed that this damage can be overcome by increasing the pumping and drainage facilities.

The purpose of the dam is to create storage on Kootenai Lake which will be of great benefit to the generation of hydroelectric power and considered as a whole the project is regarded as having much merit. The value of benefits will apparently surpass any injurious features. Any damage to Idaho interests is apparently of such a nature that it can be compensated without reducing agricultural or taxable wealth to an appreciable degree in the State of Idaho.

There are important reasons why it would be desirable to defer action on the application until the effect can be more adequately determined and considered by Idaho residents whose interests are involved. However if the Commission does not wish to defer action but wishes to give its approval it is recommended that such approval be given subject to certain conditions, designed to assure a proper protection to Idaho citizens who may be damaged or whose property may be taken, and to provide for construction and operation of the dam under the supervision of the International Joint Commission for the purpose of affording assurance to Idaho interests that the dam will be operated in accordance with the proposal of the application and so as not to increase damage from spring flood waters.

INTRODUCTION

This statement is intended to give to the International Joint Commission a brief general description of conditions in the Kootenai river drainage basin and in Kootenai Lake and Kootenai Flats in the vicinity of Bonners Ferry, Idaho, especially as they relate to the consideration by the Commission of the application of the West Kootenay Power and Light Company for permission to perform certain construction work in the Kootenai river below Nelson, B.C., including the erection of a storage dam. The statement is also intended to present certain suggestions pertaining to the Commission's action on this application.

The Geololgical Survey presents this statement from a background of knowledge gained through a somewhat intensive investigation in the United States of certain phases of the problems affecting the Kootenai river extending over a period of a year and a half. This investigation is one of the important items of a general study, undertaken by the Geological Survey at the request of the State Department, of streams along the international boundary between the United States and Canada from the Lake of the Woods westward, with respect to international questions now pending or imminent.

GENERAL DESCRIPTION OF KOOTENAI RIVER DRAINAGE AREA

The drainage area of the Kootenai river includes one of the very mountainous regions of North America. For 175 miles its watershed line follows the Continental Divide as interposed by the Canadian Rockies. It embraces a considerable portion of the western slope of this notable mountain system and the southern part of the Selkirk mountains. The altitudes of these mountains exceed 10,000 feet at many points and a large area is above 5,000 feet. The length of the Kootenai river in the general direction of its course is about 400 miles. It rises in British Columbia, flows southward for about 150 miles to the Montana line, flows for the next 150 miles or thereabout through northwestern Montana and northeastern Idaho, makes a long bend back to the north, re-enters British Columbia, and in a distance of a little less than 100 miles joins the Columbia 30 miles north of the international boundary. The area of the Kootenai river basin is 19,450 square miles, of which three-fourths is in Canada and one-fourth in the United States. A map of the basin and related features is shown in Figure 1. (Filed in the offices of the Commission.)

The basin of the Kootenai river lies 400 miles inland from the Pacific ocean, beyond high mountain ranges. Although the climate of the basin has continental characteristics its relative mildness as compared with that of similar latitudes farther east indicates that the Pacific ocean is influential in some measure thus far inland. Climatic conditions vary considerably within the basin because of the modifying effect of the high mountains. The mean annual temperature in the Kootenai Valley is about 44° and in other places in the basin it is generally within the limits of 40° and 46°. Winter temperatures rather frequently fall below zero and summer temperatures sometimes reach

100°. The average length of the period between killing frosts is about four and one-half months, but in many places it is shorter in varying degrees. These statements as to temperature apply generally to observations made at valley stations. In the mountains, conditions are undoubtedly more rigorous. The annual precipitation ranges from less than 17 inches at certain places in the valley to probably more than 70 inches at the higher altitudes. Apparently somewhat more than half the precipitation occurs in the six months from October to March and, especially in the mountains, is very largely in the form of snow, which tends to accumulate throughout the winter until warm spring days arrive to melt it.

Unlike many streams elsewhere in the country, the flow of Kootenai river follows a pronounced annual cycle of flow marked by considerable regularity. The highest waters of the year are caused by the melting of the accumulated snow in the high mountains. Usually the river becomes very low during the winter, but as spring approaches the accessions from the thawing snow cause it to rise more or less gradually, beginning in April, until the maximum flow is reached, generally in late May or June, the exact time depending upon the cumulative influence of weather conditions. Thereafter the general trend of the flow is to become steadily less until the end of the summer, when low-water conditions are again reached, to continue with relatively minor fluctuations until the following spring.

The Kootenai river is the third largest tributary of the Columbia river. It discharges three times the flow of the Mississippi river at St. Paul, or of the Potomac river at Great Falls and five times the flow of the Merrimack river at Lawrence, Mass.

The basin includes valuable mineral and timber resources, and there is notable agricultural development in the alluvial bottoms of the narrow valleys and along their margins. The region is served by transcontinental railroad systems and a number of busy towns have grown up, notably Nelson, Creston and Cranbrook in British Columbia; Bonners Ferry in Idaho and Libby and Rexford in Montana.

KOOTENAI LAKE AND RELATED FEATURES

About 18 miles north of the point where the Kootenai river returns to Canada (28 miles by river) it enters Kootenai lake, a body of water about 65 miles long, 2 to 5 miles wide, covering an area estimated roughly at 180 square miles. Through this stretch in Canada and extending upstream to the vicinity of Bonners Ferry, Idaho, an additional distance of about 50 miles by river, the channel traverses an area which it seems likely was largely occupied by the lake in former ages but which has been gradually filled in by alluvial material brought down by the river and deposited in the manner that deltas are formed. A short distance above Bonners Ferry the valley is much narrower and the gradient of the stream is much steeper.

The alluvial deposits have formed a typical flood plain. As the material has been laid down by floods, it is self-evident that the lands so formed must lie below the heights attained by floods in the valley. As a matter of fact, in a state of nature these valley lands are subject to overflow annually to a greater or less degree. In a great flood all the lowlands would be covered, resulting essentially in a greatly enlarged Kootenai lake extending upstream to Bonners Ferry. As the waters fell the lands would gradually become exposed until, when the river reached a low stage, an area of more than 35,000 acres would be uncovered on the United States side of the boundary through which the low water channel would wind in a very tortuous course. Under these conditions a large part of this area would be but very little above the level of the water in the river. The relative altitude and area of these lands as

obtained from detailed topographic surveys recently made by the Geological Survey, are shown graphically in figure 2. (Filed in the offices of the Commission.) The magnitude of the comparable valley area on the Canadian side is not authoritatively known. Because of their flatness the valley lands described are commonly known as the Kootenai Flats or Kootenai Bottoms.

Like most alluvial lands so formed the Kootenai Flats are very fertile. Bountiful crops of hay grow on those portions from which the flood waters recede early enough to permit. If the flood waters can be held back from the lands the productive area may be materially increased, and under the cultivation thus made practicable, more profitable varieties of crops may be raised. Consequently, numerous drainage districts have been formed in Idaho within the last few years to construct systems of dikes, each of which is designed to hold out the flood waters from a body of land adjoining the low-water channel of the river, suited to such reclamation as a unit. The total area included in such districts at the present time is approximately 22,000 acres. As the river water tends to seep into the diked areas when the stage of the river is high relatively to the land area, each district must be equipped with a system of drainage ditches and a pumping plant to collect and remove to the river such seepage waters and also any natural drainage waters that collect within the diked areas. As the stage of the river falls a condition is reached where seepage no longer occurs and finally the level of the river becomes so low that the lands are drained into it without pumping. Of course the pumping plants need not be operated when there is no superfluous water to dispose of.

The appendix contains a more detailed description of the drainage district enterprises and other information pertinent to consideration of the application of the West Kootenay Power and Light Company. These district enterprises represent an aggregate investment for construction of $1,200,000, but they have directly or indirectly created wealth that is appraised at a much greater amount.

A considerable additional area can undoubtedly be reclaimed by the construction of dikes. There are also probably areas, of relatively small magnitude in the aggregate, which because of unfavorable location or form cannot practically be protected from floods. In general such lands have a value for agriculture appreciably lower than that of lands that have been or can be reclaimed.

Kootenai lake discharges through a long channel known as the West arm, which extends westward about 20 miles from approximately the middle of the lake. In some places the channel of the West arm is narrow, but over most of its length it is as much like a lake as a river, and ordinarily there is extremely little fall or slope within it. At the west end of the arm, near Grohman creek, about two miles below Nelson, B.C., the water course becomes a typical river with alternating falls, rapids and pools. In the distance of about 20 miles from Grohman creek to its junction with the Columbia river, the Kootenai river falls somewhat more than 300 feet. The great fall, the large flow of the river, the natural regulating effect of Kootenai lake on the inflowing waters, and the favorable sites for the construction of dams and power houses have made this stretch of the stream an extraordinarily favorable source of power. About 250 feet of this fall is susceptible of development by power plants, and the greater portion of it has already been developed by the West Kootenay Power and Light Company, which has three large power plants within this 20-mile stretch.

APPLICATION OF WEST KOOTENAY POWER AND LIGHT COMPANY

The application of the West Kootenay Power and Light Company contemplates the construction of a dam in the Kootenai river two miles below the termination of the West arm. There are filed as a part of the application certain location maps and detail plans of the proposed dam. Reference is made

in the application to a proposal for the construction of certain compensatory works in the river immediately below and above the dam site and in the vicinity of Grohman creek directly below the termination of the West arm. The application does not present complete information regarding the compensatory works and therefore their character and effect cannot be adequately determined therefrom. It is understood that engineers of the company have made available more of the details pertaining to this feature than are shown in the application and maps but it has been impracticable to make a thorough check of the prospective effects prior to the hearing of November 6.

The dam as proposed extends across the river in two sections divided by an island which partially overflows at high stages. The section of dam in the right channel is located about 500 feet above the Canadian Pacific railroad bridge and will contain nine outlet gates, each 50 feet in width and 20 feet high with maximum clear openings of 30 feet. The dam will contain two spillway sections, one section 270 feet in length situated adjacent to the outlet gates and sharply curved in plan, the end adjoining the gate section being normal to the flow of the river and the other nearly parallel with it and connected at the upper end to the island, and a second section having a crest length of 280 feet and situated obliquely across the high-water channel on the left side at a point below the railroad bridge.

The present purpose of the construction of the dam is not to create a head for the development of power at a power plant immediately below but to increase further the regulative function of Kootenai lake by storing water in the lake, to be released during the part of the year when the natural flow becomes low. It seems probable, however, that at some future time the power company may wish to utilize this dam so far as possible for the creation of head to operate a power plant. The Geological Survey assumes that in so far as such operation by the company might involve any modification of the present plans for the manipulation of storage different from that proposed in the application, further application to the Commission for supplemental authorization would be necessary.

The application indicates that the company proposes that all stored waters held back by its dam shall surely have been released down to average low-water mark at the time the spring rise commences. Furthermore, it appears that it is the purpose of the company, by the removal of the obstructions from the river contemplated in the compensatory works, to offset the obstructing effects of the dam and appurtenant structures to such an extent that with all the regulating devices of its dam opened up, the net obstruction to flood flows during the rising water of spring would not be increased. It is proposed to operate the dam in such manner that no obstruction to the outflow from the lake will be imposed until the stage of the lake has fallen to approximately 4·5 feet above the average low-water mark; this 4·5-foot stage ordinarily occurs sometime in August. "Average low-water mark" is defined as the stage corresponding to zero mark of the official gauge at Nelson. The water will then be permitted to rise until a stage is reached 6 feet above average low water. The water level will be held at this point until the natural discharge falls to such an amount that it must be supplemented by stored water to maintain the 10,400 cubic feet per second which the company desires to maintain as the lower limit of regulated flow. In years when the supply is more plentiful than usual all the stored water might not be utilized but the application emphasizes the purpose of the company that all stored water shall be released to the average low-water mark when the spring rise commences.

The discharges to be passed by the proposed dam vary from about 4,800 cubic feet per second at extreme low water to about 150,000 cubic feet per second at maximum flood stages. During low stages the fall through the West arm is almost inappreciable but at high stages it becomes considerable. Data

supplemental to that contained in the application which have been furnished informally by the power company have been of material assistance in studying the operation of the proposed dam. It is understood that the admitted obstructive effect on the stage of water immediately above the dam caused by the construction of the dam will range from a maximum increase of 4 feet in stages at the extreme low flow of about 4,800 cubic feet per second to zero at a discharge of 27,000 cubic feet per second. It is understood also that the company's computations show a reduction of stages at the dam for discharges above 27,000 cubic feet per second.

From the study of available data the Geological Survey accepts that the proposed dam with all gates open will have an obstructive effect on stages above the dam only for discharges below 27,000 cubic feet per second or thereabout and will create no appreciable back water on the lake for any discharge.

It seems possible that there may be conflict in the spring between the primary purpose of maintaining an outflow of 10,400 cubic feet per second as closely as possible up to the time that the spring rise commences, and the agreement contained in the application to empty the reservoir to the average low-water mark at Nelson. According to data supplied by the Dominion Water Power and Reclamation Service a discharge of 10,400 cubic feet per second at Nelson corresponds to a stage of 1·5 feet above average low-water mark. The emptying of the lake from a level corresponding to this stage to that corresponding to average low-water mark at Nelson, may, it appears to the Geological Survey on the basis of information at hand, require a considerable period of time during which the power company will apparently be unable to obtain the 10,400 cubic feet per second that it desires. The removal of channel obstructions at Grohman creek may modify this condition, but the extent of such modification is not shown by available information. Although the Geological Survey assumes that the company would faithfully manipulate the storage in accordance with the proposed plan, this feature is so important to the maintenance of peace of mind and confidence among Idaho interests, that it is believed that international supervision and control should be exercised over storage regulation in order to afford the fullest possible assurance on this point.

The gates are very large and it is conceivable that there might be some mechanical defect which would interfere with opening them in the spring. It is believed, however, that under a proper supervision and control by the Commission there may be assurance that such interference would not be permitted to become injurious to Idaho interests.

ECONOMIC FACTORS RELATED TO APPLICATION

An intelligent conception of the factors related to the proposal of the West Kootenay Power and Light Company may be gained more readily if at this point certain phases of the problem of the development of the resources of Kootenai lake and Kootenai Flats are briefly presented. Comprehensive consideration, with a view to directing the development of natural resources so as to insure maximum benefit, would, it is believed, be regarded as good policy if such resources were located entirely in a single country, and undoubtedly it is also well justified, in large measure at least, where two countries are affected. In thus broadly viewing the resources involved in the waters of Kootenai lake and their adaption to man's needs two aspects appear to be outstanding. One aspect relates to the undesirability of accumulating excess waters in the lake because of their interference with the utilization of the low riparian lands, of which the largest body is the Kootenai Flats. The second aspect pertains to the value of Kootenai lake as a possible storage reservoir for increasing the low

water flow below its outlet, thus making possible the production of more power at a time when magnitude of production is a critical factor in determining the success of power projects.

Two proposals have been made for minimizing the difficulties caused by floods on Kootenai lake and the adjoining overflowed lands. One proposal suggests the diversion of the upper Kootenai river into the head of the Columbia river at a favorable location in the vicinity of Canal Flats, in British Columbia. (See figure 1, filed in the offices of the Commission, for geographical relation of features referred to.) It is understood that this plan has been studied only superficially, but it seems particularly impracticable because the diversion would be made so near the source of the Kootenai river as to intercept only a relatively small part of its flood flow, because the cost of an adequate diversion canal would probably be prohibitive and because apparently it would merely transfer the flood burden from the Kootenai to the Upper Columbia, with consequent increased damage to railroad, highway and other types of development now existing along Columbia Valley.

The other proposal contemplates enlargement of the West arm outlet to permit a more rapid discharge from the lake of inflowing flood waters, thereby requiring less capacity in the lake for the accumulation of excess waters and so tending to hold the stage of the lake at lower levels. This plan would benefit the overflow lands in Idaho, because lowering the flood heights of Kootenai lake would lower correspondingly the flood heights of the river through the Kootenay Flats It is understood that investigations of this project have been made, but so far as known the results are not fully satisfactory in showing that it would be justified. The enlargement of the West arm sufficiently to accomplish material improvement would apparently require so much excavation in narrow places as to involve heavy expense.

If Kootenai lake were utilized as a storage reservoir, the stored waters might be used for increasing the power supply not only in the Kootenai river between the lake and the Columbia river but also at some later time on the Columbia river below the mouth of the Kootenai. This feature may be indicated somewhat more concretely by the bare statement that utilization of the storage capacity contemplated in the pending application of the West Kootenay Power and Light Company—that is, a 6-foot depth over the lake at low water stage—will be sufficient to increase the dependable power supply in the 20-mile stretch of river below Nelson by probably more than 100,000,000 kilowatt hours annually. If we consider power production only and disregard other uses, the more water that can be stored in Kootenai lake the better.

It is evident that the two objectives of discharging the waters from the lake as quickly as possible for the benefit of riparian lands and of holding the waters in storage for the benefit of power development are in conflict. It may be assumed, however, that there is some meeting ground between them where the maximum aggregate benefit may be derived.

A further incidental feature of the general problem is presented in the condition that by diking out the flood waters from the reclaimed areas additional waters are sent on to the main body of the lake which thus may tend to raise the water levels in the lake slightly higher than they would have been in the natural state. Furthermore, the restriction of the flood channel by the dikes tends also to increase the slope required to maintain the flow through such restricted portion and so still further raises the water levels at upstream points.

The somewhat intensive investigations undertaken by the Geological Survey on the Kootenai river in the United States have had in view the collection of the data necessary for solving this complex engineering and economic problem which has thus been rather superficially described, not only as regards the interests of the United States but as regards the interests of Canada.

EFFECT OF PROJECT ON INTERESTS IN THE UNITED STATES

In paragraph 13 of the application it is alleged that:—

> "———the effect of the aforesaid works on the level of the Kootenay river at the international boundary line and for some considerable distance beyond said line into the State of Idaho, will be to maintain the level of said river at a slightly higher stage during the low water period than it would naturally be in some years when the level would have otherwise receded to the average low water mark or below it."

Furthermore it is alleged that:—

> " There have been in the past, however, frequent low water periods when the level of the river at the said boundary line would not have been affected in the least by said works and the necessary storage now sought by the company was then provided by nature."

The applicant submits that " the proposed works will not have any injurious effect on any interests in the United States or any State thereof."

In the opinion of the Geological Survey, the application contains no information adequately supporting these allegations. It is true that the plan of the application to hold the lake at a stage of 6 feet seems relatively modest when considered in relation to the flood heights that have caused injury in Kootenai Valley—that is, stages of 16 or 18 feet or more. Nevertheless, the effect of the proposed modification of lake levels upon the operation and maintenance of drainage districts in Idaho, contrary to the allegation of the company, would apparently be materialy injurious.

Drainage is usually accomplished by promoting the movement of ground waters to lower levels and drainage ditches are constructed to conduct the surplus waters from wet lands to lower outlets or to pumps. Because of the relatively narrow valley through which it flows the Kootenai river has in the past served very effectively through the long low-water season, in draining the flat marshy lands above Kootenai lake. The injury under the proposed modification would arise from the fact that in the last of the summer, when the river would naturally continue falling more or less uniformly until diked lands could be drained into it without pumping, the water level instead would be maintained at the 6 foot stage, actually covering some of the drainage outlets and generally making the drainage of the reclaimed lands into the river more difficult and expensive. This condition would continue in a greater or less degree through the late summer, the autumn and the first part of the winter, the extent of drawdown of the stored water depending on whether the natural supply was scanty or plentiful.

The discharge of the river does not always continue falling uniformly but is sometimes increased by autumn storms. (In illustration, note rises culminating in October, both in 1926 and 1928, as shown in figure 3, filed in the offices of the Commission.) Such increase in discharge, however, is more or less temporary and minor in comparison with the spring rise. Under the conditions of nature the increases in stage caused by such storms would occur and be added to low stages of lake and river. It is impossible to predict such storms far in advance, and it may reasonably be assumed that the storm would find the reservoir level at or near the 6-foot stage. As the increased discharge from the storm approached and entered reaches of the channel partially choked by backwater from the storage dam, river stages would be raised to an extent which would affect drainage operations more detrimentally than if the normal downward trend of the flow had not been interrupted. Thus the so-called storage line, or height up to which water levels may be considered as being affected by the storage

operations, conforms to the higher stages of backwater reached along the river in its course through the Kootenai Flats under the somewhat abnormal and aggravated condition described above.

If it is the inferential contention of the company that judging from the past there will be in the future, low-water periods when the level of the river at the international boundary would not be affected in the least by the operation of the proposed works in the storage of water in order to assure a flow of 10,400 cubic feet per second throughout the low-water period, the Geological Survey must respond that it has no information which would seem to support such contention but on the contrary such study as has been given the matter, indicates the contention to be incorrect. In the opinion of the Geological Survey the proposed works and their operation would increase the waterlogging of the diked lands and would place upon the owners an additional burden incident to contending with this condition. The burden would generally consist in the operation of the pumping plants through longer periods or at increased capacities and in the extension of the systems of interior drainage ditches.

In figure 3 are presented graphic comparisons of water levels of Kootenai lake and Kootenai river at certain points through the late summer, autumn and winter as they occur under the regimen of nature and as they would be modified by the proposed storage control. The cycle of water levels through the period specified would vary, perhaps materially, for different years but the graphs shown are believed to illustrate the general situation reasonably well. It is regretted that similar graphs cannot be presented in this statement to indicate the situation throughout the affected Idaho area, but the basic data have become available too late to make this possible.

The upper of the two diagrams applies the comparison to the period from July, 1926, to April, 1927, as to the modification of water levels on Kootenai lake and on Kootenai river at Port Hill (the international boundary). Under the plan of regulation proposed in the application, control of water levels would have commenced on July 27 and the stage of the lake would have been gradually raised to reach the 6 foot stage on August 10. This stage would have been maintained until nearly the middle of December, after which use of storage would gradually reduce the level until in April, the stage would correspond to that which would have occurred naturally. The regulated water level at Port Hill fluctuates more widely than that of the lake, because Port Hill is situated on the river and the river is a more sensitive recorder than the lake of modifications of stage caused by increased discharge from storms, and also because the regulation devices at the control dam would presumably be employed to reduce the fluctuation from such causes as much as possible, if the storm came with the lake at 6 foot stages.

The lower diagram applies the comparison to the period from August, 1928, to March, 1929, as to the modification of levels on the lake and on the river at Deep Creek, about four miles below Bonners Ferry.

Drainage District No. 8 is the closest to Port Hill of the completed Idaho drainage districts. It is therefore significant to consider that in relation to the modified water levels at Port Hill, the altitude of the lowest ground of this district is about 1750·6 feet and that of the bottom of the 48 inch drain outlet pipe is about 1744·82 feet. These data are noted at the right of the diagram. Under the conditions of 1926 the regulated water level would have been from $1\frac{1}{2}$ to 4 feet above the bottom of this outlet pipe for four months, and within 2 to 4 feet of the ground surface for about half that period. The riddance of seepage and surplus storm water from these lands would unquestionably be more difficult under the modified condition than under the natural condition.

Drainage District No. 1 is located near Deep creek and at the right of the lower diagram are shown certain elevation data in regard to it. Study of these data shows that under the proposed regulation of water levels, 1,460 acres

would have been below the water level of the peak stage of October 12, 1928, whereas, under natural conditions, this peak did not reach the level of the lowest ground in the district. The regulated water level would be $1\frac{1}{2}$ to 6 feet above the bottom of the drain outlet pipe for three months and would range within above the elevation of the lowest ground or within one foot of it for almost three months. Under the natural conditions the water level was above the lowest ground at no time during the period considered and most of the time it was three feet or more below it. It is believed that this example shows that adequate drainage of District No. 1 will be materially more difficult and expensive under the proposed regulated condition than for the unregulated condition.

The area of overflow lands in the United States may be classified as follows:—

	Acres
Area in constructed drainage districts (Assessed 21,383 acres)	22,334
Approximate area in proposed drainage districts and susceptible of reclamation	13,000
Approximate area not feasibly susceptible of reclamation	4,866
Total	40,200

Of the area susceptible of reclamation, it is understood that about 7,580 acres will be reclaimed in the near future.

Information is being obtained to show definitely the natural condition of water levels at each of the several drainage districts and the condition as it would be under artificial control such as is proposed. It will also be necessary to consider data concerning operation of the pumping plants established by the several districts as they pertain to costs, adequacy of capacity, etc., under the two conditions mentioned, although it is expected that the data obtainable will be incomplete and unsatisfactory, owing primarily to the short time that most of the pumping plants have been in operation and the consequent inadequacy of the experience both in extent of time covered and in variety of conditions met. Considerable time will be required to digest the available information to arrive at an appraisal of the damage that would be caused to the drainage districts by the operations contemplated by the company's application. An appendix to this statement is being prepared for presentation at the hearing on November 6, in which it is hoped to cover more adequately the details of effects on the various drainage districts although it is feared that this will be far less complete than would be desirable.

Any determination of damages to lands in proposed drainage projects should be based so far as possible on consideration of the essential characteristics of such lands but it will undoubtedly be necessary to supplement this information to a material degree by that gained from studying actual operations in existing districts.

In determining damages for the remainder of the lands in the United States that would be affected by the proposed storage operations, it would be necessary to give weight to numerous conditions which probably vary widely in individual tracts and so make generalization impracticable at this time.

It has been shown that water levels of the Kootenai River are a very important factor in determining the degree of success attained in the utilization of extensive areas of alluvial lands in the United States. The applicant proposes to place certain definite limits on its operation of the dam and on the consequent control of lake levels. Any appraisal of damage due to the operation of the dam would of course be based on the assumption that those limits will be strictly adhered to. It must be recognized, however, that there is at least the physical possibility that those limits might be exceeded, and that the dam might be so operated as to cause very serious damage to riparian lands and property

in excess of the damage incident to the operation specifically proposed. For example, to suggest a mere possibility, at the beginning of the high water season the flood gates of the dam might be left in place either wholly or in part, to obstruct the discharge from the lake and cause the lake levels to rise materially higher than with the flood gates removed. Similarly, the stored water might not be all released by the time the spring rise began, thereby making unavailable a certain capacity of the lake for storing spring flood waters and so tending to increase ultimate flood heights.

Property holders and residents of the United States affected have therefore good reason to require that if the proposed dam is constructed and operated, there shall exist no possibility that it will be operated otherwise than as contemplated in the application. It is believed that an effective means for affording assurance to citizens of the United States in this regard would be to provide for direct supervision and control of the operation of the dam by an international board, agreed upon by the two countries.

The construction contemplated in the application involves not only the placing of a control dam and appurtenant equipment in the channel of the river but also incident thereto the construction of coffer dams and possibly other temporary obstructions in the outlet channel. Evidently the effect of this work, considered apart from that of the proposed compensatory work, might be to retard to some extent the outflow from the lake through the West Arm, and, therefore, to increase the water levels of the lake. If the company completes such compensatory work in widening the river and removing obstructions at critical places prior to beginning construction of the dam, it would offset partially and perhaps wholly such retardation of flow. However, if the construction of the dam proceeds ahead of the compensatory work there will be created a possible danger to Idaho interests incident to increased lake levels. Idaho interests are warranted in requiring that a program of construction shall be followed which shall avoid this danger. In the short time available for studying this project the Geological Survey has been unable to obtain sufficient knowledge of the details to suggest a program to accomplish this purpose. It is believed that the most practicable solution would be for the company to prepare a program of construction consistent with this purpose and conforming to the information available to the company as to other conditions related to the construction and its effects, such program to be approved by the Commission before adoption by the company and to be followed by the company thereafter.

In paragraph 7 of its application the applicant alleges that the diking operations in the United States have confined the Kootenai river to its normal low water channel, thus depriving the river in part of the reservoir afforded by the former extensive overflow, with the result that in the low-water period the average flow of the river has been reduced and in the high-water period the average flow has been increased, and furthermore that the company has thereby been deprived of the former average minimum flow of the river and that the amount of power which the company is able to develop in the low water periods has been reduced. The application contains no data in support of this allegation. The data at hand indicate that at times of low water the typical condition of undiked lands in the United States is a state of saturation and waterlogging, rather than of being covered by water. Therefore, it is believed that diking operations could have caused extremely little if any loss in storage capacity that would have been effective in maintaining the low flow of the river. However, to the extent that the lands now diked are so low as to have been formerly subject to overflow at times of low water, as apparently inferred by the applicant, the problem prospectively confronting the districts of holding out the seepage water when the water level is held 6 feet above average low water at Nelson would be even more serious than preliminary examination of the data seems to show.

In paragraphs 11 and 13 of the application it is alleged that the compensatory work proposed to be done by the company in the vicinity of Grohman Creek will permit the discharge out of the lake of a larger quantity of water than under the present natural conditions and will therefore tend to lower the high-water level at all stages above the proposed storage line. The application contains no data in support of this allegation. The Geological Survey is disposed to assume tentatively that the proposed dam and adequate compensatory works in the improvement of the channel near Grohman creek, operated within the limits stated in the application, will not raise water levels above the proposed storage line (page 19) higher than they would be under natural conditions. On the basis of present knowledge it cannot admit, as alleged in paragraph 13, that any benefit will result to any interest in the United States by reason of decrease of high water levels caused by the proposed works, but it is unable to feel that this allegation is material. If the allegation is material the Geological Survey would desire evidence to demonstrate that fact to its satisfaction.

ACTION UPON APPLICATION

The creation of the proposed storage capacity in Kootenai lake will provide Canadian interests with a very valuable source of wealth. The project may at some time later be of some incidental benefit to power developments on the Columbia river in the United States, but this contingency is too remote to warrant consideration in this connection. It is assumed that if the application were approved and the project constructed adequate compensation would be made for any lands taken for reservoir use. It is anticipated, however, that such use in the United States would be confined only to very small areas not suited to reclamation by diking, and therefore that such use would involve no appreciable loss of agricultural resources. The project contemplated will cause damage to the drainage enterprises in the United States which embrace most of the good agricultural lands, primarily by increasing operating costs and necessitating supplemental interior drainage. However, if the power company were to assume this burden of increased costs of operation and supplying supplemental drainage by paying adequate damages, there would be essentially no destruction of agricultural resources or taxable property in the United States. The Geological Survey is of the opinion that the company's storage project is in accord with a comprehensive plan designed to insure the maximum benefit from the waters of Kootenai lake and related resources.

Although the Geological Survey is reasonably confident as to the merit of the project from the broad view point of obtaining the highest utilization of the resources and that any damages to Idaho interests will not be so great as to constitute a material deterrent to the consummation of the project, it appreciates that there are numerous citizens of the United States who would be affected by the project, who have insufficient basis for similar confidence and naturally therefore will oppose the approval of the application. It is believed that the digesting of the information already collected would go far in showing the facts to such persons so that they could form intelligent opinions for themselves of the effect of the project on their interests. The analysis and dissemination of such information had been considered by the Geological Survey as a very important item of the program in preparing for consideration of the anticipated application of the power company. It was proposed to study the behaviour of Kootenai river as it actually occurred and as it would be modified by the proposed dam, in relation to the effect upon the various drainage districts or other interests. Data for such a study, including data

collected by the Dominion Water Power and Reclamation Service on the Canadian side of the boundary has only become available during the past few days, indeed some important data are even yet not in shape for use. It has been utterly impracticable therefore to analyze these data in the manner contemplated, prior to this hearing; in fact it is estimated that an orderly and thorough analysis would require several weeks. The Commission will undoubtedly appreciate that there would be much merit in a contention on the part of the individuals intimately affected by the project that they should have this information before the application is acted upon. There would also be much merit in a contention on the part of the United States interests that any damages should be determined and compensated before the company is allowed to proceed with construction, because, otherwise there is introduced very disturbing uncertainty as to the promptness and adequacy of adjustment.

However if the Commission is not favorably impressed by these reasons for postponing action on the application, it is recommended that the application, if approved, should be subject to the provision of (1) assurance of adequate remedy for any damages to citizens of the United States because of the effect of the proposed works and their operation on valley lands, now diked or proposed for diking in future, and because of the flooding of lands for the creation of power values; (2) a program of construction adopted by the company, subject to approval by the Commission, which shall provide for completion of compensatory work in the removal of obstructions from the channel of Kootenai river, before any obstructions such as coffer dams or any other temporary or permanent structures are placed in said channel, which can conceivably cause back-water damage to property in Idaho above the proposed storage line, said compensatory work to be adequate in the opinion of the Commission to offset such possible damaging effect, and supervision of said construction by the Commission sufficient to afford assurance to residents of Idaho that this condition is being complied with; and (3) international supervision and control of the operation of the storage dam to determine that it is operated properly and to afford assurance to citizens of the United States that it is being so operated.

The determination of damages is a complex question, and considerable time will be required to handle it satisfactorily. It is to be emphasized that it would be preferable, so far as United States interests are concerned, if approval of the application could be deferred until after this question is settled. Any conclusion relative to what may constitute suitable and adequate provision for the protection and indemnity against injury of the interests on the United States side of the boundary should be made in the light of the attitude of the citizens and residents of the United States who are vitally concerned, as presented at the hearing at Bonners Ferry on November 6.

The matter of the adoption of an acceptable program of construction is very important. It can probably be handled most effectively by an international board of engineers acting as an agency of the Commission to insure compliance and reporting to the Commission on essential features.

International supervision and control also can probably be best handled by an international board of engineers with authority and power to determine whether the company is operating in accordance with its agreement and also to require the company to do whatever such board deems necessary relative to the operation of the dam and manipulation of storage in order to insure compliance with the agreement.

APPENDIX TO STATEMENT OF UNITED STATES GEOLOGICAL SURVEY TO INTERNATIONAL JOINT COMMISSION RELATIVE TO THE APPLICATION OF THE WEST KOOTENAY POWER AND LIGHT CO., LTD., FOR THE APPROVAL OF THE CONSTRUCTION OF A STORAGE DAM AND COMPENSATING WORKS IN THE KOOTENAI RIVER AT OR NEAR GRANITE, B.C., AND OF THE PLANS THEREFOR.

INTRODUCTION

This appendix presents certain information and notes concerning the drainage districts in Kootenai Flats in Idaho and the effect of the storage project of the West Kootenay Power and Light Co. upon them, which it was impracticable to include in the original statement of the Geological Survey to the International Joint Commission. This compilation contains the data which it has been possible to obtain within the limited time available and it is hoped that it may aid in giving a more comprehensive view of the situation affecting the lands involved. It is to be emphasized that these data fall far short of showing the information that is essential to a full appraisal of the effect of the storage project upon the lands.

GENERAL STATEMENT

During the past ten years the reclamation of Kootenai valley in Idaho, by land draining and diking, has been proceeding rapidly, somewhat in contrast to reclamation by irrigation in other sections of the state which has progressed relatively slowly. A general map of the valley, Figure 4 (filed in the offices of the Commission), shows the location of the drainage districts with respect to Kootenai river and the international boundary. Districts numbered 10, 11, and 12, are as yet unconstructed although it is understood preliminary organization of these districts has been completed and that construction of No. 10 will be started soon.

These reclamation enterprises are in small units. While some advantages would doubtless have resulted if larger units had been adopted, it is also true that the small unit system has made it possible to provide effective colonization of each project and has resulted in actual farm operations by large scale methods following closely after construction. The natural richness of the soil and the favorable topography of the raw lands have hastened the period of profitable returns on these comparatively new projects.

Table 1 shows the progress of reclamation, the areas involved, the costs of construction, and the appraised values of the constructed drainage districts. A study of this sheet is interesting and discloses that reclamation experience in the Kootenai Flats is of comparatively short duration, that the average area of the constructed districts is somewhat less than 2,500 acres, that costs of construction have been moderate, averaging somewhat less than \$60 per acre, and that the appraised valuations for bonding purposes have varied from \$100 to \$150 per acre. (See Table on p. 293.)

The gross return per acre, representing the 1929 crop, has been estimated at \$50 for the entire area of nearly 22,000 acres within the nine constructed districts. The progress evidenced by these apparently profitable yields compares favorably with the returns from irrigation projects older in experience. The costs of construction are considerably lower than the costs estimated for the construction of many proposed or recently constructed irrigation projects in

similar climates. The present land values in Kootenai valley as appraised for bonding purposes are doubtless conservative in spite of the possibility of overflow during years of extreme floods, and these values are claimed to be considerably less than current market prices in the valley.

Of the remaining 18,000 acres of undeveloped land above the international boundary, about 13,000 acres are probably as susceptible of profitable reclamation as the average of the developed areas. More than half of these better lands are included in organized districts prepared to proceed with construction in the near future. On basis of the rate of development of existing projects it seems reasonable to assume that most of the remaining lands will be diked within a few years leaving the least desirable lands in their natural state until the last.

With so small an area remaining for future development, the efforts of the farmers of Kootenai valley have turned toward more intensive farming. Heretofore, wheat and hay in general have been the staple crops but now attention is turned to the possibilities of growing potatoes, asparagus, sugar beets, lettuce, peas, and other garden products. The naturally rich soil, the favorable climatic condition and ready marketing facilities combine to encourage this greater diversification of crops. Some experimental work has already been done with a view to proving which varieties of crops are best adapted to the local conditions. It is expected that successful growth of crops other than wheat and hay will require deeper drainage of the soil than is effected by the present drainage works. Some of the districts may seek lower outlets and larger pumps to effect a general lowering of the water table both during the flood season and the long low-water season when gravity drainage is possible. It is not unreasonable to assume that diversification of crops in bringing greater cash returns may increase values represented in reclaimed lands to a point where the costs of increased flood protection and better drainage will be justified.

The program for the development of the agricultural resources of Kootenai valley in Idaho has progressed so far with considerable success. While information concerning the remaining undeveloped sections of the valley is perhaps more or less speculative, there appears to be no reason to believe that reclamation of most of the new lands as contemplated will not be followed with about the same degree of success as experienced by the constructed projects.

Profiles of the water surface of Kootenai river for several days have been developed from Boom Camp, Idaho, to Granite, B.C., and are shown in figure 5. (Filed in the offices of the Commission.) The dates selected are those when the water levels in Kootenai lake correspond more or less closely to the maximum levels of the proposed plan of operation outlined in the application. Profiles as shown illustrate average low-water conditions and actual slopes observed at times when the Nelson gauge recorded 4·5 feet and 6·0 feet, respectively. Several different conditions are indicated, at or approximating the latter stage. The river slopes through the Kootenai flats are affected noticeably by the quantity of water passing down the river in relation to the stage of Kootenai lake. The profiles depict natural conditions actually observed while figure 3 represents seasonal determinations in which the regulated cycle of water levels has been calculated. Attention is called to the fact that the average low-water profile shown on figure 5 is representative of higher lake stages than those occurring during many low-water seasons. Also, higher river discharges are represented in the other profiles than will occur except at rare intervals during the average storage season.

In figures 6, 7 and 8 (filed in the offices of the Commission), eight profiles of the ground surface across the valley have been developed from topographic maps at different points crossing the various drainage districts. The informa-

TABLE NO. 1.—GENERAL INFORMATION RELATIVE TO DRAINAGE DISTRICTS IN KOOTENAI VALLEY, IDAHO

Drainage District Number	Progress of Reclamation			Area		Cost of Construction				Appraised Value (b)	
	Date of Organization	Works Constructed	District Cropped	Measured on Topographic Map (includes Right of Way, etc.)	Assessed for Benefits	General, Dikes, etc.	Interior Drain Ditches Outlets, Pumps, etc.	Total		District	Per Acre
								District	Per Acre		
1	10/21/20	1920–21	1921–29	4424	4371	$ 186,200	$ 55,000	$ 241,200	$ 55	$ 655,700	$ 150
2	7/ 5/24	1925–26	1926–29	683	679	34,800	3,200	38,000	56	101,800	150
3	7/14/24	1925	1926–29	1156	1052	50,050	8,700	58,750	56	157,800	150
4	7/17/24	1925–26	1926–29	3381	3127	164,650	29,850	194,500	62	462,800	148
5	12/13/24	1924–25	1925–27, 1929	983	906	58,000	12,500	70,500	78	135,900	150
6	8/14/25	1925–26	1928–29	5601	5352	243,735	55,765	299,500	56	682,400	127 50
7	9/14/25	1928	1929	2165	2076	123,907	14,093	138,000	66	259,500	125
8	1/ 2/26	1926	1927–29	2921	2558	120,174	23,826	144,000	56	319,800	125
9	2/ 6/26	1926–27	1927–29	1025	941	(a) 13,020	5,000	18,020	19	94,100	100
Totals	....	....	....	22,339	21,062	....	....	1,202,470	57	2,869,800	136

(a) Estimated.

(b) Appraised by State Bond Commissions before districts were constructed. Present appraisals would probably be more consistent with respect to all the districts than are those shown in the table.

October, 1929.

tion on water levels presented in figures 3 and 5 has been transferred to those sheets in so far as is practicable in order that the relation between river levels and adjacent lands may be observed. The elevations of the various drain outlets are shown both in relation to land levels and river levels and a definite picture of the general situation is presented. High stages are also shown and the need for higher dikes to protect against extreme floods is indicated.

Competent engineers have stated that complete drainage in these districts will require that outlet structures be lowered to an elevation of about 8 feet below the level of the lowest land in the district and drain ditches be lowered accordingly where necessary and where the subsoil material will permit without causing undue seepage and boils. While it is assumed that an examination of the ground surface profiles shows plainly the desirability of lowering present drain outlets and the possibility of so doing and retaining the gravity flow during the low-water season, it is desired to call particular attention to this even greater lowering of drainage outlets that may be required by the program of deeper drainage and diversification of crops incident to the highest development of the lands. A table is inserted showing the relation between elevations of drainage outlets and the lowest ground as they exist at present and as would be desirable for the best use of the lands.

TABLE NO. 2

District number	Elevation bottom of outlet at inside of dike (Feet)	Elevation lowest ground (Feet)	Difference (Feet)	Area within 8 feet of drain outlet (Acres)	Suggested elevation bottom of outlet (Feet)	Average low water level (Unregulated) (Feet)
1	1,745·1	1,748	2·9	2,130	1,740	1,742·1
2	1,755·8	1,759	3·2	300	1,751	1,742·8
3	1,748·6	1,754	5·4	310	1,746	1,741·7
4	1,751·0	1,751	0·0	2,680	1,743	1,741·1
5	1,750·7	1,753	2·3	560	1,745	1,741·6
6	1,743·0	1,748	5·0	1,050	1,740	1,740·9
7	1,747·5	1,748	0·9	1,020	1,740	1,741·9
8	1,745·0	1,750	5·0	1,920	1,742	1,740·8
9	1,748·4	1,750	1·6	480	1,742	1,741·1

The present total fall between the lowest ground level and the bottom of the outlet gate in every district is apparently less than is desirable for best drainage results. Instead of 8·0 feet of fall as probably needed for adequate drainage, the above table shows the constructed districts have an average fall of only 2·9 feet. The areas now being cropped within an elevation of 8·0 feet above present outlets total 10,450 acres, which represents 46 per cent of the entire area within the constructed districts. The last two columns of the table show the relative elevations of average low water and of the various outlets as suggested. It will be noted that if the outlets were lowered properly the gravity drainage would be adequate for stages at or below average low water in all drainage districts except Nos. 1, 6, and 7. Reference to the individual area-elevation curves on figure 9 (filed in the offices of the Commission) shows that the only appreciable areas of low ground (within 8 feet of average low-water level) are in Districts 1 and 6. It must be admitted in some cases, however, that deep drainage ditches in diked areas may prove to be a menace during flood periods unless they are located with extreme care in order that boils or blowouts through unfavorable sub-surface soil will not develop. Table No. 2 indicates that practically the entire area could be drained effectively by gravity

during the low-water season if the outlets were lowered as suggested. It is readily seen, however, that the margin between the suggested outlet elevations and average low-water level is so small that the increased river levels resulting from proposed lake storage would prove damaging to the plan. With the outlets lowered as suggested, gravity drainage would be retarded in all cases except in that of District No. 2.

An analysis of the acreage in constructed districts within 2, 4, 6, and 8 feet of the normal river stage, with 6 feet of storage water in Kootenai lake, follows in table No. 3.

TABLE NO. 3

District No.	Approximate elevation of normal river stage with 6 feet storage in Kootenai Lake	Area of Lands in Constructed Districts				
		At 6 feet normal storage level	Within 2 feet above 6 feet normal storage level	Within 4 feet above 6 feet normal storage level	Within 6 feet above 6 feet normal storage level	Within 8 feet above 6 feet normal storage level
1	1,748·0	0	820	1,680	2,500	3,040
2	1,748·2	0	0	0	0	0
3	1,747·9	0	0	0	0	250
4	1,747·3	0	0	0	25	500
5	1,747·8	0	0	0	10	25
6	1,747·1	0	160	1,100	2,600	3,620
7	1,747·9	0	10	280	780	1,070
8	1,747·0	0	0	15	1,740	2,550
9	1,747·2	0	0	60	210	350
Total		0	990	3,135	7,865	11,405

The elevations of the regulated river levels adjacent to each drainage district as shown are approximately representative of normal river conditions during the period when the storage plan contemplated holding Kootenai lake at the 6-foot level. If for any reason the river discharges above the lake are increased by heavy rains or chinooks during the storage period, the river elevations will be correspondingly increased. The magnitude of the effect during these periods depends on the rate of change of discharge as well as the duration and amount of the increased flow. Such periods of increased discharge, due to precipitation or thawing snow, are not infrequent even during fall months. The river levels may also be raised above the normal storage line by backwater effects resulting from ice obstruction in the channel. In considering the acreages in each district which lie within 2, 4, 6, and 8 feet of the proposed regulated river level, the above mentioned possibilities should be borne in mind. Also, to aid in the comparative study it should be remembered that the natural river elevations for the corresponding period average 3 to 4 feet lower than the regulated levels. Although no land lies below the regulated river level, 3,135 acres lie within 4 feet and 11,405 acres lie within 8 feet thereof. The table clearly shows the possibility of water-logging large areas by the proposed storage plan, particularly within Districts Nos. 1, 6, and 7.

In addition to the general information outlined above, there is indicated below a brief discussion covering information applicable to each of the existing drainage districts with respect to pumping operations in so far as such information is available.

Drainage District No. 1.

Owing to the relatively low elevation of a large part of the area in Drainage District No. 1, considerable pumping is required to provide adequate drainage. Following is a record of the pumping operations of the District, 1923 to 1929, inclusive, as compiled from data furnished by officials of the district and from other sources:—

Year	Pumping Record (Hours)	Annual Cost of Pumping		
		Power only	Operation	Total
		$	$	$
1923	216	1,454·50	450·00	1,904·50
1924	No record	125·00	150·00	275·00
1925	184·6	1,987·40	600·00	2,587·40
1926	*300·0	228·10	450·00	678·10
1927	2,048·0	2,176·25	750·00	2,926·25
1928	1,936·0	4,375·41	3,510·72	7,886·13
1929	306·0	1,675·37	405·00	2,080·37
Average (7 years)		1,717·43	902·25	2,619·68

*Estimated.

Since the bottom of the drain outlet is approximately 3·0 feet below the lowest ground elevation in the district, any submergence on the outlet is seriously detrimental to gravity drainage. With 6·0 feet of storage in Kootenai Lake, the drain outlet will be submerged about 3·0 to 4·0 feet during periods of average river flow occurring generally throughout the fall and early winter while at times this submergence might be greatly increased during periods of increasing river discharges. Therefore, under conditions of storage regulation it is likely that during the average year pumping would be required from 100 to 200 days longer than under natural conditions to obtain drainage comparable with that at present with the probability that some additional pumping equipment would be needed and possibly additional interior drain ditches might also be required to provide better drainage facilities than now exist.

Drainage District No. 2.

The land in Drainage District No. 2 is considerably higher in elevation than that of any of the other districts, and will probably not be affected by storage regulation in Kootenai Lake. Elevation of the gravity drain outlet is 1,755·8 feet while elevation of the lowest land is 1,759·0 feet, and the average elevation of river water level that will probably occur during period of storage regulation with lake at the 6-foot level is about 1,748 to 1,749 feet. Due to a portion of the district area being underlain with a porous gravel formation through which water seeps easily, there should be no material water-logging of the land caused by short periods of high water level in the river. It is believed that no additional interior drainage or pumping will be made necessary by the proposed regulation of Kootenai lake.

Flood stages during spring high water period are especially detrimental to this district because of the comparatively rapid seepage of river water into the low ground of the district through the underlying porous formation. Therefore, if an increase in high water level of Kootenai river in the United States were caused by Kootenai Lake storage, District No. 2 would probably suffer more severely than would any of the others. The dikes around District No. 2 are high enough to withstand the average high water.

Available data on cost of pumping are tabulated as follows:—

Year	Total	Per acre
	$	$
1926	No expense	0·00
1927	1,697·51	2·50
1928	816·54	1·20
1929	No expense	00

Drainage District No. 3.

The drain outlet for Drainage District No. 3 will not be submerged during the period of Kootenai Lake storage regulation except at times of considerable increases in river discharges. None of the land is within about 6·0 feet, and only 250 acres within 8·0 feet, of the average river stage that will occur with 6·0 feet of stored water in Kootenai Iake, and the drain ditches have adequate slope for good drainage; therefore, very little damage to the district will probably result from the proposed storage scheme.

Following is a tabulation of available data on pumping costs for the district:—

Year	Total	Per acre
	$	$
1927	4,110	3.98
1929	735	.70

The capacity of pumps was inadequate in 1927 and 1928, largely because of considerable surface inflow from the adjacent hillside during those years.

Drainage District No. 4.

At the 6·0 feet storage level in Kootenai lake, the bottom of the drain outlet for Drainage District No. 4 will not be submerged except for short periods when the river discharge is increasing rapidly and only at such times will pumping probably be required during the period of storage regulation. However, since the drain outlet is 5·4 feet below the lowest ground elevation in the district, it is likely that interior drainage by gravity will be less effective under the proposed storage regulation when the water level of the river would be close to the level of the gravity outlet than under natural conditions when such water level is three or four feet lower. In this case, better drainage facilities will be required.

Pumping costs for the years during 1927 to 1929, inclusive, are shown as follows:—

Year	Pumping Record (Hours)	Annual Cost of Pumping		
		Power only	Operation	Total
		$	$	$
1927	No record	3,566	681	4,247
1928	No record	1,507	4,622	6,129
1929	512	444	1,506	1,950

Drainage District No. 5

All of the land in Drainage District No. 5 is probably sufficiently high in relation to the regulated river level to be unaffected by the proposed storage project.

Following is a summary of available data on pumping costs of the district:—

Year	Total	Per acre
	$	$
1927	2,289	2·53
1928	No data	....
1929	325	0·36

Drainage District No. 6

During periods of ordinary river flow in the fall, the bottom of drain outlet for Drainage District No. 6 will be submerged about 4·0 feet when lake storage is at the 6·0-foot level in which case the river level would be within about 1·0 foot of the lowest land in the district, thus creating a condition unfavorable to proper drainage. At times of river freshets this condition would become considerably worse.

Owing to the fact that the drain outlet is only 5·4 feet lower in elevation than the lowest ground elevation, pumping would often be required to obtain adequate drainage. During average years, it is estimated the pumping season would be lengthened possibly as much as 150 days under storage regulation. It is also possible that the interior drainage system would need to be enlarged to provide better facilities for the collection of water.

Detailed records of previous pumping operations and costs are not available. In June, 1927, one of the dikes broke, while in 1928 pumps were operated from April 27 to August 19 during which time the pumps were in operation about 2,100 hours. During 1929, a 16-inch centrifugal pump was operated about 5 hours a day from May 1 to July 1.

Drainage District No. 7

Nearly all land in Drainage District No. 7 is above 1,750 feet in elevation, the bottom of drain outlet being at 1,747·5 feet and average river water level at the drain outlet during lake storage regulation is about 1,748 feet. It is therefore apparent that the drain outlet will be submerged during a considerable portion of the period when regulation is in effect and will be totally submerged at times of freshets or increases in stage due to ice obstruction. The present drainage of ground water into the river channel during the fall and winter low water period relieves the low ground of the district on three sides, the average winter river level being 1,741 to 1,743 feet under natural conditions. An extensive system of additional interior drainage will no doubt be required by the proposed regulation of Kootenai lake and the pumping season will be lengthened possibly from 100 to 200 days over the time required for pumping under present conditions.

No data are available as to pumping costs, but a figure of 350 hours as the total time pumps were operated in 1929 is considered fairly reliable. The average discharge was about 3·5 cubic feet per second through a 12-inch centrifugal pump.

Drainage District No. 8

The lowest ground in the district is at an elevation of about 1,750 feet. Of the total area of 2,921 acres within the dikes, about 2,000 acres lie between elevations of 1,751·5 and 1,753·5; 220 acres being below the former and 700 acres above the latter.

During the flood season of 1927, ground water elevations were observed by L. T. Jessup for a period of two weeks, June 13-28, and are presented in a report to the Commissioner of Reclamation of the State of Idaho. Kootenai river at Port Hill was at peak stage varying from 1,761 to 1,762·5 feet, or about 10 feet above the level of the main body of land within the dikes. During the two weeks period, ground water elevations raised but little inside the dikes.

The elevation of the lowest drainage outlet is 1,745·2 feet. An outlet elevation of 1,742 feet would be necessary to furnish drainage to the depth suggested above as assuring the best results. During the storage season which would have prevailed in 1926-1927, the period of open outlet conditions would have been decreased from 260 to 101 days by the proposed storage regulation. Had the outlet been located at the suggested lower elevation, the period of open outlet conditions would have been decreased from 112 days to 35 days.

Available data on operation of pumps is shown below:—

Year	Pumping Record		Annual Cost of Pumping		
	Days	Pump	Gas and Oil	Labor and Rental	Total
			$	$	$
1927	40	8″	850·00	1,500·00	2,350·00
	15	6″			
1928	No record		......	......	1,392·81
1929	No record		......	......	390·01

Drainage District No. 9

The elevation of the bottom of the drain outlet for Drainage District No. 9 is 1,748·4 feet or slightly less than 2 feet lower than the lowest ground elevation. The ground, in general, is more rough and rolling than in other districts in the valley and the existing system of interior drain ditches is entirely inadequate for draining much of the low land of the district. The average natural low water level in river at the drain outlet varies from an elevation of 1,740 to 1,743 feet while under regulated conditions with 6·0 feet of storage in Kootenai lake, the average river level would be about 1,747·2 feet, or within three feet of the lowest ground surface. It therefore seems likely that some additional interior drainage facilities might be required for this district to provide adequate drainage under regulated conditions. Present information is insufficient to show whether additional pumping would be necessary after lake storage regulation is in effect.

The costs of pumping for the years 1927 to 1929, inclusive, are tabulated as follows:—

Year	Total	Per acre
	$	$
1927	752·11	0·80
1928	333·00	0·35
1929	0·00	0·00

J

RESPONSE TO APPLICATION

Response to the Application of West Kootenay Power and Light Company, Limited, for approval of the construction of a storage dam and compensating works and plans therefor in the Kootenay river at or near Granite, British Columbia.

To the Honorable, the International Joint Commission, Washington, D.C., and Ottawa, Canada.

The undersigned, counsel for the Honorable H. C. Baldridge, Governor of the State of Idaho, on relationship of the State of Idaho, and Drainage Districts Nos. 1 to 11, both numbers inclusive, of the County of Boundary, in the State of Idaho (all hereinafter called the respondents), with the consent of the Government of the United States of America first having been obtained, respectfully say in response to the application of the West Kootenay Power and Light Company, Limited, as follows:—

I

That your respondents herein appear specially for the purpose of replying to the application of the West Kootenay Power and Light Company, Limited, hereinafter called the company, reserving however and without waiving their right to question the authority of the International Joint Commission to determine in any way any of the questions submitted to said Commission by said application, it being the opinion of respondents that the resolution of the Senate of the United States of March 3, 1909, ratifying the treaty between the United States and Great Britain, relating to boundary waters and questions arising between the United States and Canada, limits the powers of the International Joint Commission, and expressly provides as follows:—

> ". . . that nothing in this treaty shall be construed to interfere with the drainage of wet swamp and overflowed lands into streams flowing into boundary waters, . . ."

II

Respondents admit the allegations set forth in paragraphs 1, 2, 3, 5, 8, 9, 12 and 14 of said application of the company.

III

Answering paragraph 4, of said application, respondents admit that the company is the owner of several water licences granted by the province of British Columbia in respect of water flowing in the Kootenay river at several natural power sites below the site of the proposed storage dam at which sites the company has erected large power plants, but respondents deny that said plants have an installed maximum capacity of one hundred and seventy thousand (170,000) horsepower, and deny that one of said plants requires ten thousand four hundred (10,400) cubic feet per second of the water to flow continuously through said plant to enable it to produce continuously its installed horsepower and for which amount of water the company owns a licence from said Provincial Government.

IV

Answering paragraph six (6) of the application of said the company, respondents deny that the flow in the Kootenay river varies from average high water of one hundred and seven thousand (107,000) cubic feet per second in summer months to four thousand eight hundred (4,800) cubic feet per second in the winter, and deny that during November, December, January, February and March of each year the water flowing is frequently only sufficient to operate the two larger plants of the company at fifty per cent capacity.

V

Answering paragraph seven (7) of the application of said the company, respondents deny that the construction of earthen dikes on acreages of land between Bonners Ferry in the State of Idaho, U.S.A., and the international boundary line at Port Hill, Idaho, which confines the Kootenay river in flood stages to its normal low water channel, deprived the river of any storage reservoir; and deny that as a result in the low water period, the average flow of the river has been reduced; and deny that in the high water period, the average flow has been increased; and deny that any construction work in the aforesaid acreages has resulted in depriving the company of a considerable portion of the former average minimum flow of the river, or any portion whatsoever of any former flow of the river; and deny that the amount of power which the company is able to develop in the low water periods has been at any time, or at all, reduced by any construction work or development of agricultural lands in the United States of America; and allege that at times of low water, the condition of the lowlands in the United States of America was a state of saturation and waterlogged, and not one of being covered by water, and that the effect of said diking operations has not been such as to cause the loss of but little, if any, storage capacity that could have been effective in maintaining the low flow of the river.

VI

Answering paragraph ten (10) of the application of the said the company, respondents deny that the construction of a proposed dam of said the company will not increase the natural elevation of the waters in Kootenay river or Kootenay lake at any stage above the proposed storage line.

VII

Answering paragraph eleven (11) of the application of said the company, respondents deny that the compensatory work proposed to be done by the company in the vicinity of Grohman creek will permit of the discharge out of the lake of a larger quantity of water than under the present natural conditions and will, therefore, tend to lower the high water at all stages above the said storage line, and deny that the proposed dam will be so constructed as to take care of a flow equal to that of the aforesaid 1894 flood.

VIII

Answering paragraph thirteen (13) of the application of said the company, respondents deny that the effect of the aforesaid works on the level of the Kootenay river at the International Boundary Line and for some considerable distance beyond said line into the State of Idaho would be to maintain the

level of said river at a slightly higher stage during the low water period than it would naturally be in some years when the level would have otherwise receded to the average low water mark or below it; and alleges that the said proposed works would maintain a level of said river at a considerable higher stage during said low water period; and respondents deny that there have been in the past at any time frequent low water periods when the level of the river at said boundary line would not have been affected in the least by said proposed works. Respondents deny that said proposed works will not have any injurious effect on any interests in the United States or any state thereof; and respondents further deny that the said proposed works will tend to decrease the high water levels at said boundary lines and beyond it; and deny that said proposed works would be beneficial to all interests in the United States and particularly to the State of Idaho; and deny that said benefit is being sought by said interests.

IX

Answering paragraph fifteen (15) of the application of said the company, respondents deny that any power whatsoever is required by the company for the purpose of assisting the Consolidated Mining and Smelting Company of Canada, Limited, in operating large, extensive and costly plants in order to utilize the gases which it is at present emitting from its smelter stacks and which it is claimed are causing a nuisance in the State of Washington, U.S.A., and deny that the company will require a large additional supply of electric power within a very short time in order to operate said plants; and deny that the company finds it necessary to obtain this power at as early a date as possible; and deny that the said company has no means at its disposal to provide such power as the Consolidated Mining and Smelting Company of Canada, Limited, may require, other than through the storage project set forth in the application of said the company.

AFFIRMATIVE RESPONSE

Respondents further and affirmatively answering the application of the West Kootenay Power and Light Company, Limited, respectfully oppose in whole any order of approval of said application, and respectfully submit to said Honorable, the International Joint Commission, as follows:—

I

(*a*) That the said International Joint Commission has no authority to approve the said application of the company or the said plans submitted with the said application by virtue of the provisions of the resolution of the Senate of the United States consenting to the ratification of the treaty between the United States and Great Britain, relating to boundary waters and questions arising between the United States and Canada, dated at Washington, D.C., the 13th day of May, 1910, which said resolution provides in part as follows:—

> "Resolved further, as a part of this ratification, That the United States approves this treaty with the understanding that nothing in this treaty shall be construed as affecting, or changing, any existing territorial or riparian rights in the water, or rights of the owners of lands under water, on either side of the international boundary at the rapids of the St. Mary's river at Sault Ste. Marie, in the use of the waters flowing over such lands, subject to the requirements of navigation in boundary waters and of navigation

canals, and without prejudice to the existing right of the United States and Canada, each to use the waters of the St. Mary's river, within its own territory, and further, that nothing in this treaty shall be construed to interfere with the drainage of wet swamp and overflowed lands into streams flowing into boundary waters, and that this interpretation will be mentioned in the ratification of this treaty as conveying the true meaning of the treaty, and will, in effect, form part of the treaty;"

(*b*) For the further reason that the provisions of rule nine (9) of the Rules of Procedure of the International Joint Commission have not been complied with in that the secretaries of the International Joint Commission have not caused to be published for three (3) successive weeks in a weekly newspaper at Bonners Ferry, Boundary County, State of Idaho, U.S.A., or at any other place in the State of Idaho, U.S.A., a notice that the said application has been made, and of the nature and locality of the proposed use, object or diversion, and that all persons interested therein are entitled to be heard in respect thereto before the Commission, said Bonners Ferry, Idaho, being the place of publication of a weekly newspaper on the United States of America side of the international boundary line nearest the locality in which the use, object or diversion of waters is in said application proposed to be made.

II

That your respondents, Drainage Districts Nos. 1 to 11, both numbers inclusive, are duly organized and existing quasi-municipal corporations in the State of Idaho, controlling, maintaining and operating approximately 23,000 acres of highly developed and exceedingly valuable agricultural land along the Kootenay river between Bonners Ferry, Idaho, U.S.A., and the international boundary line at Port Hill, Idaho; that the development, operation, maintenance and cultivation of said lands in said Kootenay Valley maintain and support a population of approximately 4,000 principally located at Bonners Ferry, Boundary county, Idaho, and the city of Bonners Ferry, Idaho, is absolutely and totally dependent for its existence upon the operation and development of said lands.

III

That should the proposed projects of the West Kootenay Company be constructed, irreparable injury would be caused to the lands of your respondents within the State of Idaho owing to the fact that if the water level at the low water stage is maintained above said present low water stage, said lands within the State of Idaho would become water-logged to such an extent that cultivation of such lands would be rendered absolutely impossible.

IV

Respondents allege that the work proposed to be done by the company in the vicinity of Grohman creek will not permit of the discharge out of Kootenay lake of a larger quantity of water than under the present natural conditions, and will not to any extent whatsoever lower the high water level of the Kootenay river and that said proposed work, if done, will be done for the purpose of constructing more satisfactory power developments for the company and not for the purpose of doing compensatory work for the benefit of interests outside of the Dominion of Canada.

V

That the effect of the proposed project of said the company will be to so retard the flow of the Kootenay river that the present great quantities of silt now being carried and extensively distributed over said river and Kootenay lake will be extensively retarded and deposited within the Kootenay river channel within the boundaries of the United States of America, and such deposits will be of so great a nature that the river channel will in a very few years be filled to such an extent that complete overflow of lands in the State of Idaho will be accomplished, and only great expenditures on said river by the United States of America can be anticipated in order to prevent such damage.

That the proposed project of said the company, if completed, would so raise the low water level in Kootenay lake that there would be no natural reservoir, storage facilities in said lake at the time of the flood conditions of the Kootenay river, with the ensuing result that the flood stage of said river would be increased to such a height that it would top and destroy the valuable reclamation projects of your respondents and absolutely and totally prevent any cultivation whatsoever of the valuable agricultural lands within the United States of America.

Wherefore, the undersigned hereby request your Honorable Commission to wholly disapprove the plans of said the company and wholly refuse to approve the construction of said proposed project of said the company.

Respectfully submitted,

W. D. Gillis,
Attorney General for the State of Idaho.

Fred J. Babcock,
Assistant Attorney General.

Residence and Post Office,
Boise, Idaho.

O. C. Wilson,
Residence and Post Office,
Bonners Ferry, Idaho.
Counsel for the Respondents.

K

STATEMENT OF MR. W. J. TINDALE, DESIGNING ENGINEER, WEST KOOTENAY POWER AND LIGHT COMPANY, LIMITED

PROPOSED DAM AT GRANITE, B.C., FOR CONTROL OF KOOTENAY LAKE

Any references made to elevations will refer to Geodetic Survey of Canada datum, 1928 adjustment. Two-tenths of one foot must be added to all elevations to bring them to datum of the United States Coast and Geodetic Survey.

I wish to refer briefly to the following sources from which we obtained gauge records, and other data, which were used in our calculations. Dominion Government, Department of the Interior, Water Power and Reclamation Service. Dominion Government, Department of Public Works. British Columbia Government Water Rights Branch.

Our thanks are due to engineers of these departments who gave us free access to available records.

Records and drawings of the Department of Public Works, for several years of daily gauge readings, at Nelson, Proctor, and Kootenay Landing, were available, also Water Records of the British Columbia Water Rights Branch.

Important Geodetic Survey of Canada data, and gauge readings, also cross sections of the river from the lake above Grohman Narrows to Granite, and at Proctor were obtained from the Dominion Water Power and Reclamation Service.

Our investigations indicated that the site at Granite, as shown on Drawing 1152, was the most suitable one for a dam, having as its object storage control of Kootenay lake. This site provides rock foundations and has the width necessary for a structure to pass the maximum flood. Immediately below the gate section of the proposed dam, the river falls rapidly and we have taken advantage of this fall to obtain the required discharge under flood conditions.

After deciding on the best location for the dam we located gauges Nos. 1, 2, 3, and 4 at various points betweeen the site and the lake within a distance of 2¼ miles and Nos. 5 and 6 within a distance of 3600′ below the dam.

Location of gauges Nos. 1 to 5 is given on Drawing 1152. Gauge No. 6 is 2,000′ downstream from gauge No. 5. Records of these gauges have been kept from May 24, 1928, to the present date.

Gauge No. 1 was placed at the lake just upstream from the narrows at Grohman creek. No. 2 just below the narrows, No. 3 2640′ below No. 2, and No. 4 in comparatively level water just upstream from the proposed site. In the distance between No. 1 gauge and No. 4 gauge the total fall in the river is 13·8 feet with 10,000 c.f.s. flow and 9·0 feet with 132,000 c.f.s. flow.

Gauges Nos. 4 and 5 were located to record the fall in the river immediately below the dam. It was found that the fall is 15·0 feet with 10,000 c.f.s. flow and 12·4 feet with 132,000 c.f.s. flow.

Additional gauges, Nos. 10, 11, 12, 13, and 14 were installed within a distance of four miles below the dam, to record this year's flow.

Nos. 10, 11, 12, and 13 were placed at control points to obtain data, in case it was found necessary to excavate to lower existing water levels below the dam.

No. 14 gauge was placed 600′ downstream from the dam, as a check on water levels at gauge No. 5 situated 1600′ downstream from the dam. Gauge readings show that when flow is less than 25,000 c.f.s. water elevations at these gauges are the same, but when flow exceeds 25,000 c.f.s. water surface at No. 14 gauge is slightly lower than at gauge No. 5.

This indicates that we are justified in calculating water slopes from a point 700′ downstream from the sluice gates.

Records of gauges 7 to 26 inclusive, installed by the Dominion Water Power and Reclamation Service, at various points between Granite and the main lake, were also available.

Flow of 150,000 c.f.s. at Nelson, B.C., based on available records, was exceeded in the following years:—

1894—	Nelson	gauge	height	28·2′	flow	estimated	200,000	c.f.s.
1903—	"	"	"	21·6′	"	"	151,000	"
1913—	"	"	"	20·3′	"	"	141,000	"
1916—	"	"	"	21·0′	"	"	147,000	"
1928—	"	"	"	19·1′	"	"	132,000	"

Our method of indicating water elevations, at the various stages of flow, is shown on Drawing D-9.*

*This and other drawings mentioned in Mr. Tindale's statement are filed in the offices of the commission in Ottawa and Washington.

The curves shown on this drawing were drawn through points arrived at by plotting known discharges against the water elevations, up to the maximum for 1928 high water.

Not having gauge readings or high water marks for discharge greater than for 1928 except No. 4 gauge and at Nelson, we continued the curves to cover the extreme flood of 1894.

High water elevation for 1916, at a point corresponding to No. 4 gauge, has been obtained from a drawing made by the British Columbia Water Rights Branch.

This drawing gives an elevation agreeing with our calculated elevation for 1916 high water at No. 4 gauge.

High water marks for 1894 have been indicated by our residents who were present during that year, at locations corresponding to No. 4, No. 5 and No. 6 gauges.

These marks, when checked to Dominion of Canada Geodetic Survey datum, by independent engineers, give elevations four-tenths of a foot lower at No. 5 gauge and six-tenths higher at No. 4 gauge than our calculated elevations given on Drawing D-9.

The structure which we have designed, shown on Drawings D-1, D-2 and D-3, consists of free crest spillways 550′ long and a series of 9 Stoney gates having a span of 50′ each between the piers.

Sill of the gates is at an elevation of 1726·00 and crest of spillways is at an elevation of 1742·50.

Stoney gates have been found efficient and reliable for structures of this type. The gates provide a tight seal when necessary to shut off flow and are suited to large openings where necessary to pass a large amount of water.

Method of raising and lowering the gates which rise and fall on anti-friction rollers is by means of electric hoists operated from an overhead bridge. This bridge is supported by steel towers which rise from the concrete piers.

The entire structure is designed with ample safety factor to withstand all loads. The gates will be protected against ice formation which might interfere with successful winter operation. At the end of the storage season all gates will be raised and suspended well above the maximum flood level.

Drawing D-1 indicates the general arrangement of the dam. We found that it will be necessary to excavate 10,000 cubic yards of rock above the structure to permit free flow to the gates and 120,000 cubic yards below the gates to provide efficient discharge areas. All discharge channels will be made smooth with even slope downstream to obtain a small coefficient of roughness.

Additional excavation of 25,000 cubic yards will be necessary in East Channel to permit low velocity below C.P.R. bridge spans to the spillway dam.

The result of our calculations for new water elevations at the dam are shown on Drawing D-13. The lower line on this drawing indicates present water elevations at a point 700′ downstream from the gates. Slope of the water surface up to the gates was calculated on basis of Manning's formula for flow of water in open channels. This formula was adopted after checking various results with Kutter's formula.

Calculations for flow through gates was based on Fteley and Stearns submerged weir formula and flow over spillways on Francis's formula.

Calculated new water elevations above the dam with all gates open are shown on Drawing D-13 by a full line representing the new levels at gauge No. 4. The new levels under flood conditions are considerably lower than existing water levels which are shown by a dotted line.

Grohman Creek Narrows approximately 2 miles above Granite is a control point principally responsible for the present high flood water elevations on the lake.

No. 2 gauge is located just below these narrows and the present fall between the lake and this point is 4·5′ with 132,000 c.f.s. flow and calculated at 6·8′ with 200,000 c.f.s. flow. In order to obtain a flat hydraulic grade from the lake to the dam under low water storage conditions we propose excavation of 90,000 cubic yards in the narrows above No. 2 gauge. This work will result in a flattening of the hydraulic grade through the narrows and will lower the lake 3·6′ with 200,000 c.f.s. flow. This is indicated on drawing D-13. This lowering of the lake will be increased on account of a betterment which results from an increased hydraulic grade between No. 2 gauge and the dam due to the lowered water surface at that point. The net result of these improvements will be a lowering of existing levels at Nelson by slightly more than 4·0 feet with 200,000 c.f.s. flow. Four-tenths of one foot of this amount will be lost between Grohman Narrows and the main lake, but the net lowering of the main lake, effective at Kootenay Landing, will be slightly more than 3·6 feet with 200,000 c.f.s. flow.

Method proposed for control of water during the storage season is indicated on drawing D-16. On basis of this drawing the lake would come under control when it falls to elevation 1743·32, 4′ above the Nelson gauge zero.

At any time after August 31, when the lake has fallen to the 4′ mark on Nelson gauge, the gates would be closed to pass only sufficient water for power purposes, and the surplus would be held back to raise the lake to the storage lines. In 1927 the lake did not fall below the 5′ mark on Nelson gauge before November 13, and did not reach the 4′ mark until December 11.

As soon as amount of water coming into the lake is less than amount required for power, we would begin to take water from storage and the lake would fall as shown by the flow lines. Elevation of the water would be maintained not lower than No. 1 storage line and not higher than No. 2 storage line until natural flow at the begining of the annual rise is greater than amount required for power. At this time all gates will be raised to pass the annual flood.

The following data pertains to sluices and land in reclamation districts in Idaho, U.S.A. Distances given are based on calculated length of the West Arm of Kootenay lake, the main lake and the winding river channel above Kootenay Landing.

No. 8	sluice	is	78	miles	from	Nelson,	B.C.	Invert	elevation	1744·82
No. 6	"	"	85	"	"	"	"	"	"	1742·76
No. 1	"	"	121	"	"	"	"	"	"	1744·94

These three sluices are the only ones which will be reached by our maximum storage line.

No. 9	sluice	94	miles	from	Nelson,	Invert	elevation	1747·78
No. 4	"	97½	"	"	"	"	"	1750·77
No. 5	"	112	"	"	"	"	"	1750·50
No. 3	"	114	"	"	"	"	"	1748·30
No. 2	"	125½	"	"	"	"	"	1755·62

On account of the higher water elevation due to storage the cross sectional area of the river will be larger than at present from Kootenay Landing to Bonners Ferry. This will cause slower velocity of flow and consequently a flatter slope of water surface than under present conditions.

On December 1, 1928, flow at Nelson, B.C., was 9,300 c.f.s. and water elevations based on gauge readings were as follows: Nelson 1740·52, Porthill, 1741·31, Copeland 1741·44 and Bonners Ferry 1742·88.

Hydraulic grades from Nelson to No. 8 sluice at Porthill was ·79′, from Nelson to No. 6 sluice ·86′, and from Nelson to No. 1 sluice, 2·16′.

Our calculations indicate that hydraulic grades will be less than above under storage conditions due to the larger cross sectional area of the river. If

we use the above hydraulic grades, however, water will be below No. 8 sluice with water at Nelson gauge at elevation 1744·03 and below No. 6 sluice with Nelson gauge elevation 1741·90 and No. 1 sluice with Nelson gauge elevation 1742·78.

Considering the highest flow line on Drawing D-16, No. 8 sluice will be above the water surface on February 1, No. 6 sluice on March 9, and No. 1 sluice on February 23.

We are led to believe that the lowest land to be drained in Nos. 8, 6 and 1 reclamation districts is at the following elevations: No. 8 district lowest land 1,752·35 or 7·53 feet above the sluice outlet and 6·55 feet above our maximum storage line as shown on Drawing No. D-4; No. 6 district lowest land 1,750·27 or 7·51 feet above the sluice outlet and 4·37 feet above our highest storage line; No. 1 district lowest land 1,750·68 or 5·74 feet above the sluice outlet and 4·68 feet above our highest storage line.

Considering the sluices in the remaining districts at elevations as shown on Drawing D-4 are above our highest storage line; our storage scheme will not interfere with natural drainage in the remaining reclaimed districts.

Our calculations indicate that river improvements at Grohman Creek will have a definite effect on lowering lake levels at all flow stages when the dam is not operating for control of storage.

The lowering of lake levels will hasten the fall of the water to lower levels after the flood peak is reached and will permit earlier summer work on land not protected by dykes.

Our studies indicate that very little if any silt is carried down the river during the low water period but that a considerable amount is carried down during the flood season. Dredging of this deposited material is necessary at Kootenay Landing at intervals in the interests of navigation. The increased velocity of flow due to the lower water surface of the river will have the effect of carrying silt further into the lake and will be of some benefit in keeping the river channel open.

The work which we propose in connection with the dam construction will not interfere with any future schemes which might have as their object further lowering of the lake in the interests of reclamation.

We have endeavoured to design a structure which if built will be simple and efficient for control of storage and which will benefit navigation and impose no hardship on reclamation.

Our proposed work will maintain low water slightly above present levels and will lower flood levels on the lake and in the river above Kootenay Landing. This in case of an extreme flood would be of distinct benefit to reclamation and navigation interests.

L

SUPPLEMENTAL RESPONSE

To the Application of West Kootenay Power and Light Company, Limited, for Approval of the Construction of a Storage Dam and Compensating Works and Plans therefore in the Kootenay River at or near Granite, British Columbia, all hereinafter Referred to as "Respondents."

To the Honorable the International Joint Commission, Ottawa, Canada, and Washington, D.C.

The undersigned, as Solicitors for Honorable C. Ben Ross, Governor of the State of Idaho, on relationship of the State of Idaho, and Drainage Districts Nos. 1 to 13, both numbers inclusive, of the County of Boundary in the State

of Idaho, with the consent of the Government of the United States of America first having been obtained, respectfully say in further response to the application of the West Kootenay Power and Light Company, Limited, as follows:—

I

That the respondent, State of Idaho, is one of the States of the United States of America, and Honorable C. Ben Ross is the duly elected, qualified and acting Governor of said State, and the respondents, Drainage Districts Nos. 1 to 13, both numbers inclusive, of the County of Boundary in the State of Idaho, are duly organized and existing quasi-municipal corporations of the State of Idaho controlling, maintaining and operating approximatley 30,000 acres of highly developed and exceedingly valuable agricultural land along the Kootenay river between Bonners Ferry, Idaho, United States of America, and the international boundary line betwen the United States of America and the Dominion of Canada, at Porthill, Idaho.

II

That the West Kootenay Power and Light Company, Limited, hereinafter called the "company," is a corporation chartered by special act of the Province of British Columbia, Canada, being Chapter 63 of the Statutes of British Columbia, 1897, and the amendments thereto, being found in Chapter 78 of the Statutes of British Columbia, 1911, and Chapter 76 of the Statutes of British Columbia, 1929, and said company is authorized to acquire and hold water licenses and develop and sell power therefrom, and do all things necessary or incidental thereto.

III

That in the year 1929 the said company filed with the Honorable, the International Joint Commission, "Application of West Kootenay Power and Light Company, Limited, to the Honorable the International Joint Commission for Permission to Construct and Operate Certain Permanent Works in and Adjacent to the Channel of the Kootenay River, for Storage Purposes, at Granite, British Columbia," reference to said petition being hereby made; that at a hearing before the Honorable, the International Joint Commission, at Bonners Ferry, Boundary county, Idaho, in November, 1929, the International Joint Commission continued said hearing for the purpose of obtaining additional data upon which to consider the company's application; that since that time no additional data or plans were furnished by the company and no continued hearing on said application has ever been held.

IV

That under and by virtue of a treaty between the United States and Great Britain, relating to boundary waters and questions arising between the United States and Canada, which treaty went into effect on the 5th day of May, 1910, and still remains in full force, power and effect as originally entered, it is provided as follows:—

"ARTICLE II

"Each of the High Contracting Parties reserves to itself or to the several State Governments on the one side and the Dominion or Provincial Governments on the other as the case may be, subject to any treaty provisions now existing with respect thereto, the exclusive jurisdiction and control over the use and diversion, whether temporary or permanent, of all

waters on its own side of the line which in their natural channels would flow across the boundary or into boundary waters; but it is agreed that any interference with or diversion from their natural channel of such waters on either side of the boundary, resulting in any injury on the other side of the boundary, shall give rise to the same rights and entitle the injured parties to the same legal remedies as if such injury took place in the country where such diversion or interference occurs; but this provision shall not apply to cases already existing or to cases expressly covered by special agreement between the parties hereto.

"It is understood, however, that neither of the High Contracting Parties intends by the foregoing provision to surrender any right, which it may have, to object to any interference with or diversions of waters on the other side of the boundary the effect of which would be productive of material injury to the navigation interests on its own side of the boundary.

"ARTICLE III

"It is agreed that, in addition to the uses, obstructions, and diversions heretofore permitted or hereafter provided for by special agreement between the parties hereto, no further or other uses or obstructions or diversions, whether temporary or permanent, of boundary waters on either side of the line, affecting the natural level or flow of boundary waters on the other side of the line, shall be made except by authority of the United States or the Dominion of Canada within their respective jurisdictions and with the approval, as hereinafter provided, of a joint commission, to be known as the International Joint Commission.

"The foregoing provisions are not intended to limit or interfere with the existing rights of the Government of the United States on the one side and the Government of the Dominion of Canada on the other, to undertake and carry on governmental works in boundary waters for the deepening of channels, the construction of breakwaters, the improvements of harbours, and other governmental works for the benefit of commerce and navigation, provided that such works are wholly on its own side of the line, and do not materially affect the level of flow of the boundary waters on the other, nor are such provisions intended to interfere with the ordinary use of such waters for domestic and sanitary purposes.

"ARTICLE IV

"The High Contracting Parties agree that, except in cases provided for by special agreement between them, they will not permit the construction or maintenance on their respective sides of the boundary of any remedial or protective works or any dams or other obstructions in waters flowing from boundary waters or in waters at a lower level than the boundary, in rivers flowing across the boundary, the effect of which is to raise the natural level of waters on the other side of the boundary unless the construction or maintenance thereof is approved by the aforesaid International Joint Commission.

"It is further agreed that the waters herein defined as boundary waters and waters flowing across the boundary shall not be polluted on either side to the injury of health or property on the other."

V

That in disregard of the above-mentioned treaty and in flagrant violation thereof, and with absolute disregard of the moral obligations due and owing to the Honorable, the International Joint Commission, and the respondents

herein, in connection therewith, and with utter disregard of the legal obligations imposed by virtue of said treaty and with absolute and intentional bad faith in its conduct to and toward the Honorable, the International Joint Commission, and the respondents herein, and while the said application of the company for permission to construct and operate certain permanent works in and adjacent to the channel of the Kootenay river, for storage purposes, at Granite, British Columbia, referred to in paragraph III hereof, was pending before the Honorable, the International Joint Commission, and before any order of the Commission in accordance with the prayer of said application had been made or entered, the said company has constructed a dam on the Kootenay river at Corra Linn, British Columbia, at a point about six miles below Granite, British Columbia, where the company originally petitioned for a permit to construct a dam, said Corra Linn being near the outlet of the west arm of Kootenay lake in British Columbia.

VI

That said dam constructed by said company has raised the water in the Kootenay river in Idaho, in the United States of America, at the international boundary line and south therefrom, more than two feet above the normal and natural low-water level, and has retarded the flow of water in Kootenay river; has used up the natural storage capacity of Kootenay lake, and has raised the water table in the agricultural lands of the respondents to such an extent that the lands have become saturated and water-logged, and has prevented the water from draining from said agricultural lands and prevented the tilling of the soil and has caused the loss of sub-surface storage of water at the high-water stage of the Kootenay river, which is one of the necessary factors in preventing the overflow of the Kootenay river upon said land during the flood season.

VII

That the present storage of said water in Kootenay lake, caused by the illegal act of the company in constructing said dam in direct and flagrant violation of the said treaty referred to in paragraph IV hereof, and in utter and flagrant disregard and violation of the order of the Honorable, the International Joint Commission, continuing said hearing, will result in the flood stage of the Kootenay river being increased to such a height that it will top and destroy the valuable reclamation projects of the respondents, and absolutely and totally prevent any cultivation whatsoever of the valuable agricultural lands of respondents in the State of Idaho, within the United States of America.

VIII

That unless the water now stored in Kootenay lake by the company is immediately released and said lake returned to its normal low level, irreparable damage will be caused to the respondents as there will not be sufficient storage facilities to handle the flood waters in the coming flood season, as the natural storage capacity of Kootenay lake has been one of the necessary and essential saving factors which has prevented overflows in the past, and it is necessary that the respondents have immediate relief as it will be a physical impossibility for this water to be discharged from Kootenay lake within time to furnish any relief to the respondents unless an immediate order is made by this Commission directing this company to forthwith release said flood waters and lower the level of Kootenay lake to its natural state.

Wherefore, your respondents pray that the Honorable the International Joint Commission, forthwith and without further hearing, order said West Kootenay Power and Light Company, Limited, to drain from Kootenay lake the water stored by it and lower the level of Kootenay lake to its natural state, and that it forthwith remove any and all obstructions placed by it in the Kootenay river or Kootenay lake in violation of said treaty.

Respectfully submitted,

FRED J. BABCOCK,
Attorney General of Idaho,
Residence and Post Office, Boise, Idaho.

O. C. WILSON,
Residence and Post Office, Bonners Ferry, Idaho,
Solicitors for Respondents.

M

REPLY

OF THE APPLICANT TO THE SUPPLEMENTAL RESPONSE OF THE RESPONDENTS IN AN APPLICATION BY WEST KOOTENAY POWER AND LIGHT COMPANY LIMITED FOR PERMISSION TO CONSTRUCT AND OPERATE CERTAIN PERMANENT WORKS IN AND ADJACENT TO THE CHANNEL OF THE KOOTENAY RIVER AT OR NEAR GRANITE, BRITISH COLUMBIA, FOR STORAGE PURPOSES.

To the Honourable, The International Joint Commission,
Ottawa, Canada, and Washington, D.C.

The undersigned, as solicitor for the West Kootenay Power and Light Company Limited, hereinafter called the applicant, makes reply to the Supplemental Response of the Respondents, State of Idaho and Drainage Districts Numbers 1 to 13 both numbers inclusive of the County of Boundary, in the State of Idaho as follows:—

(1) That the applicant admits the allegations of fact contained in paragraphs 1, 2, 3 and 4 of the said Supplemental Response except that allegation contained in paragraph 1 thereof which states that the respondent drainage districts control, maintain and operate approximately 30,000 acres of highly developed and exceedingly valuable agricultural land, the applicant denying that said land has been highly developed and denying that said land is exceedingly valuable agricultural land.

(2) In reply to paragraph 5 of the said Supplemental Response the applicant states that while the applicant's application for storage rights on Kootenay lake based upon permanent works to be constructed at Granite, British Columbia, was pending it has constructed a dam on the Kootenay river at Corra Linn, British Columbia, which point is from five to six miles below Granite, British Columbia, and about nine miles below the outlet of the West arm of Kootenay lake in British Columbia, and the applicant denies all other allegations of fact contained in said paragraph 5, and more specifically denies that said dam was constructed in disregard of the Treaty mentioned in the said Supplemental Response or any section thereof, and denies that the said dam was constructed in flagrant violation or any violation thereof, or that said dam was constructed with absolute disregard or any disregard of the moral

obligations or any obligation due and owing the Honourable the International Joint Commission, and the respondents herein, and denies that said dam was constructed with utter disregard or any disregard of the legal obligations imposed by virtue of said Treaty and denies that said dam was constructed with absolute and intentional or any bad faith toward the Honourable the International Joint Commission or the respondents herein.

(3) The applicant further states in answer to said paragraph 5 that the said dam as constructed at Corra Linn, British Columbia, by the applicant was constructed purely and solely as a power dam under and pursuant to legal rights to do so obtained by the applicant from the Government of the Province of British Columbia acting through its duly appointed officials for that purpose, and because the construction of said dam so long as it was operated as a purely power dam without also being operated as a storage dam would not raise the natural level of the waters of Kootenay river on the United States side of the boundary line it was not necessary for the applicant to apply to the Honourable the International Joint Commission for permission to effect said construction or such operation as such construction and such operation of said dam would not come within the ambit of said Treaty.

(4) The applicant further states in answer to said paragraph 5 that the said dam at Corra Linn, B.C., is capable of being used as a storage dam when and in the event of the consent of The Honourable the International Joint Commission being given to so use it, and that no greater cost was incurred in the construction of said dam to make it possible to use it as a storage dam than would have been incurred were it being erected to serve as a power dam only without such storage.

(5) The applicant denies each and every allegation of fact contained in paragraph 6 of the said Supplemental Response and in further reply thereto states that upon completion of the said dam at Corra Linn the applicant partially closed the sluice gates of said dam for the purpose of creating a pondage in the Kootenay river above the said dam, and at the same time to create in the said river and Kootenay lake an amount of storage which the applicant considered could be created without raising the natural level of the water at the international boundary line, and if in creating such pondage and such storage the level of the Kootenay river on the United States side of the international boundary line was raised, it was done inadvertently, without knowledge of what the words "natural level" used in said treaty meant, and not with the intention of violating the aforesaid Treaty, nor with any intention of disregarding the moral or legal obligations due and owing to the Honourable the International Joint Commission, nor the respondents herein. The applicant is aware that it is necessary under said Treaty to obtain the consent of the International Joint Commission before it can operate the said dam to store water in Kootenay lake and river to the point where the natural level of the river would be raised at the international boundary line, and has to that end now filed an Amended Application with the said International Joint Commission.

(6) The applicant further states in reply to paragraph 6 of the said Supplemental Response that at no time either during the construction of the said dam or in its operation since the completion of said dam, has the applicant done anything to injure the respondents' lands or anything that would result in the raising of the water table of the agricultural lands of the respondents, and that if the natural level of Kootenay river was raised at the international boundary line inadvertently, as mentioned above, nevertheless it was not raised to the point where complete drainage of the respondents' land could not be effected, as the level of the river adjacent to said lands has at all times been, since the completion of said dam, below the point where complete drainage

could have been effected from the said lands, and that if the said lands were not drained completely it was because of the voluntary act of owners of the said lands in closing the drainage sluice gates to maintain in the drainage ditches a higher level of water to raise the water table in said lands for the greater benefit of the crops to be grown thereon during the year 1932, or because of other causes having no relation to the level of Kootenay river.

(7) The applicant further states in reply to paragraph 6 of the said Supplemental Response that the following figures, which show the elevations of Kootenay river, the elevations of the drainage sluices of Districts Nos. 1 and 6 (being the two lowest drainage sluices of the thirteen districts) and the elevations of the water standing in the drainage ditch inside of the said sluice gates, fully substantiate the statements made in the immediately preceding paragraph. On November 21, 1931, when the elevation of Kootenay lake was at its highest level subsequent to the 10th of October, 1931, the date when the gates of Corra Linn dam were partially closed, the elevation of Kootenay river at the international boundary line was 1742·41 feet and the elevation of Kootenay river at the gauge nearest No. 1 District drainage sluice was at 1742·92 feet; the elevation of the bottom of the outlet of No. 1 District drainage sluice is at 1743·30 feet and the level of the water in the ditch on the inside of the gate of said No. 1 sluice was actually at elevation 1743·76 feet on November 24, 1931, being the nearest date when readings were taken, thus showing that there was a difference between the level of the Kootenay river and the bottom of the drainage outlet of about four and one-half ($4\frac{1}{2}$) inches, which would allow of complete drainage of said sluice, and a difference between the river level and the level of the water in the drainage ditch of over ten (10) inches. The gauge readings of the level of the water within said ditch show that the level thereof increased after November 24 until it reached an elevation of 1744·46 feet on December 21, 1931, making a difference of one foot three and one-half inches (1 ft. $3\frac{1}{2}$ in.) between the level of the water within the ditch and the level of the river at that time, which latter had increased to elevation 1743·16 feet in consequence of additional natural flow of water in the river.

The lowest sluice outlet of any of the districts is No. 6, which is at elevation 1742·80 feet, and on November 21 the level of the river was about three-tenths of a foot (·3 ft.) or over three and one-half ($3\frac{1}{2}$) inches below the bottom of said sluice outlet. The elevation of the water in the drainage ditch inside of said sluice outlet was, on November 28, 1931, being the nearest date when gauge readings were taken, at 1741·95 feet, being lower than either the river level or the drainage outlet, showing complete drainage. As all other sluice outlets are higher than either No. 1 or No. 6, a greater difference in the level of the river and the level of the sluice outlets existed, ensuring complete drainage if desired by the respondents.

It has been noted above that the level of the Kootenay river at the Bonners Ferry gauge rose, between November 21, 1931, and December 23, 1931, over three (3) inches, while at the boundary line, between the same dates, it lowered over one (1) inch, this difference being caused by the natural increase in the flow of the river.

The above figures are all taken from the records of the United States Geological Survey transposed to Geodetic Survey of Canada Datum 1928 Adjustment by deducting two-tenths (·2) from the U.S. Geological Survey figures.

(8) The applicant denies each and every allegation of fact contained in paragraph 7 and further in reply thereto states that the construction of the said dam at Corra Linn and of the compensatory work already constructed in

the Kootenay river between Granite, B.C., and Corra Linn, will not have the effect of increasing the flood stage on Kootenay river, but will, on the contrary, have the effect of reducing said flood stage by one-half (·5) of a foot when the flow from said lake equals one hundred thousand (100,000) cubic feet per second to one and seventh-tenths (1·7) feet when the flow equals two hundred thousand (200,000) cubic feet per second.

(9) In reply to paragraph 8 of the said Supplemental Response the applicant states that if any water was so inadvertently stored in Kootenay lake and river, the same has been entirely released so that the level of Kootenay lake is now below the average low water level, being ·27 of a foot, or 3·24 inches below the zero of the Nelson, B.C., gauge.

Respectfully submitted,

R. C. CROWE,
Solicitor for West Kootenay Power and Light Company Limited

Dated at Trail, B.C., this 22nd day of February, 1932.

N

LIST OF EXHIBITS WEST KOOTENAY POWER AND LIGHT COMPANY LTD.—GRANITE DAM

West Kootenay Power and Light Co. Ltd.

Exhibit 1—Watershed Map, Kootenay River. 1917.

Exhibit 2—Storage graph, Kootenay Lake. 1929.

Exhibit 3—General Arrangement of Sluice Gates. 1929.

Exhibit 4—Details of Sluice Gates. 1929.

Exhibit 5—Typical section through spillway. 1929.

Exhibit 6—Profile of Kootenay River and Lake. 1929.

Exhibit 7—Map of Kootenay River showing proposed dam. 1929.

Exhibit 8—Section calculations for flow and gauge records. 1929.

Exhibit 9—Curves showing flow and water elevation. 1929.

Exhibit 10—River contours and proposed excavation, Grohman Narrows. 1929.

Exhibit 11—Comparison of proposed and present water levels on lake and river. 1929.

Exhibit 12—Licences for diversion and use of water held by applicants.

Exhibit 13—Comparisons of discharge of Kootenay River at Nelson, B.C.

United States Geological Survey

Exhibit 14—Appendix to Statement by the United States Geological Survey filed October 31, 1929.

O

AMENDED APPLICATION

Of West Kootenay Power and Light Company, Limited, to the International Joint Commission for Approval of Works in the Kootenay River and for the Right to Store Water in Kootenay Lake

To the Honourable the International Joint Commission,
Ottawa, Canada, and Washington, D.C.

The undersigned, as solicitor for the West Kootenay Power and Light Company Limited (hereinafter called the company) respectfully represents:—

(1) That the company is a corporation chartered by special Act of the province of British Columbia, Canada, being chapter 63 of the Statutes of British Columbia, 1897, and amendments thereto, being found in chapter 78 of the Statutes of British Columbia, 1911, and chapter 76 of the Statutes of British Columbia, 1929, copies of which said Act and said amending Acts are set forth as Appendix 1 to the original application herein, the purpose of the company as set forth in said Act and amending Acts being that of acquiring and holding water licences, and the developing and selling of power therefrom and doing all things necessary or incidental thereto, including the building of dams and compensating works for the storage of water in rivers, streams or lakes within a radius of one hundred and fifty (150) miles from the city of Rossland, in said province.

(2) That the company by said charter is authorized to purchase, acquire and hold land and real and personal property that may serve the purpose of its incorporation.

(3) That the company is in a position financially to carry out the proposed works hereinafter referred to.

(4) That the company is the owner of several water licences granted by the Province of British Columbia in respect of water flowing in the Kootenay river at several natural power sites in that stretch of the river between the city of Nelson, British Columbia, and the mouth of the Kootenay river where it flows into the Columbia river, at which sites the company has erected large power plants at a cost of several millions of dollars and which plants have an installed maximum capacity of about two hundred thousand (200,000) horsepower, which plants require ten thousand four hundred (10,400) cubic feet per second of water to enable them to produce continuously their installed horsepower.

(5) That the Kootenay river has its source in eastern British Columbia, near the fifty-first parallel. It flows in a southerly direction into Montana, U.S.A., thence westerly to Bonners Ferry, Idaho, U.S.A., thence northerly and crosses into British Columbia at Port Hill, Idaho, and discharges into Kootenay lake near Kootenay Landing, B.C., approximately twenty-eight (28) miles from the international boundary.

Kootenay lake has a length of sixty-six (66) miles with an average width of two to three miles and an area of one hundred and seventy (170) square miles. The West arm, which branches off from the main lake near Proctor, B.C., has a length of twenty (20) miles and emerges into a continuation of Kootenay river, through narrows at Grohman creek, about two (2) miles westerly from Nelson, B.C. The twenty (20) mile stretch of river between Grohman creek and the confluence with the Columbia river has sufficient fall for other valuable power developments in addition to those above mentioned.

(6) That the flow in the Kootenay river varies from average high water of one hundred and seven thousand (107,000) cubic feet per second in summer months to four thousand eight hundred (4,800) cubic feet per second in the winter. During November, December, January, February and March of each year the water flowing is frequently only sufficient to operate the two larger plants of the company at fifty per cent capacity, whereas during the high water period a very much larger amount of water than is required flows down the river.

Maximum peak flow since the year 1900 occurred in 1903 when the flow in the Kootenay river below Nelson was approximately one hundred and fifty-one thousand (151,000) cubic feet per second and the level of Kootenay lake at Nelson stood at 21·6 feet above the Nelson gauge zero mark. The highest water on record occurred in 1894 when the level at the same point was 28·2 feet above zero and about two hundred thousand (200,000) cubic feet per second was flowing in the river below Nelson.

Usually the annual rise in the water levels commences about the end of March and it reaches its flood peak generally between May 25 and July 10 and on receding, about the end of August, reaches the level of four and one-half feet (4·5 feet) above the zero mark on the gauge at Nelson, B.C., which zero mark is the average low water level based on the average low water flow for several years.

(7) That at the time when the company first commenced its power development on the Kootenay river aforesaid very large acreages of land between Bonners Ferry in the State of Idaho, U.S.A., and thence northerly to the international boundary line at Port Hill, Idaho, were flooded by water from the Kootenay river during the months of each year constituting the high water period and as the river fell later in the season, acted as a reservoir for the said river, but in recent years very large portions of said acreages have been reclaimed by confining the Kootenay river to its normal low water channel between earthen dikes thus depriving the river of said reservoir with the result that in low water period the average flow of the river has been reduced and in high water period the average flow has been increased which in turn has resulted in depriving the company of a considerable portion of the former average minimum flow of the river and therefore reducing the amount of power which the company is able to develop in the low water periods.

(8) That the company now has an application, dated September 6, 1929, before the International Joint Commission for the approval of the construction of a storage dam and compensating works and plans therefor in the Kootenay river at or near Granite, B.C., and a public hearing in connection therewith was held by the said Commission at Bonners Ferry, Idaho, on November 6, 1929, which said hearing was adjourned without final action at the request of the representatives of certain interests in the State of Idaho, in order that further scientific studies could be made as to the effect that the proposed works would have on property in the State of Idaho, which said studies the company realized would delay any final action on its said storage application for at least one year.

(9) The Consolidated Mining and Smelting Company of Canada Limited, the chief power customer of the company, had undertaken to the International Joint Commission in certain proceedings then before the said Commission, to construct extensive sulphuric acid and fertilizer plants at Trail, B.C., to utilize the sulphur gases coming from its smelter, and by so doing to relieve the situation that had arisen in consequence of its said gases drifting over the international boundary line and resulting in claims of damage being made by residents of the State of Washington, the said undertaking being to the effect that said plants would be in operation by August or September of the year 1931, and

in the operation of which plants a very large amount of electric power would be required, which said power was not then available and could not be made available unless the power company could increase its production of electric power either through the said storage of water on Kootenay lake, or through the erection of another power plant to supply the additional power during the winter of 1931-1932 and thereafter.

(10) In consequence of the above mentioned facts the power company commenced the construction of a power dam and power plant at Corra Linn, B.C., being on the Kootenay river about five (5) miles below the site of the storage dam proposed to be constructed at Granite, B.C., in the company's original application to this Commission, and completed said dam about the 10th of October, 1931. The power plant however is not yet completed but it is expected to be completed within the next two or three months.

(11) The said dam at Corra Linn, B.C., has been so constructed that it can be operated efficiently solely as a power dam without raising the level of the river at the international boundary line. It can also be operated to provide the storage of water in Kootenay lake requested in the company's original application but by so doing the level of Kootenay river would be raised at the Boundary line and therefore the consent of the International Joint Commission is necessary to the operation of the dam as a storage dam under and pursuant to Article IV of the Treaty of January 11, 1909, between the United States and Great Britain. In the building of the said dam no additional cost has been incurred to make it available as a storage dam than would have been incurred were it to be used purely as a power dam.

(12) The company states that in addition to the completion of the said dam at Corra Linn, B.C., it has removed from the bed and banks of Kootenay river between the said dam and Granite, B.C., large quantities of rock and gravel in order to facilitate the free flow of Kootenay river between said points, but that this work will not result in the natural level of Kootenay river at the boundary line being raised at any time or in any way, but will have the effect of lowering Kootenay lake during the high water from one half foot when the flow from the lake equals one hundred thousand (100,000) cubic feet per second to 1·7 feet when the flow equals two hundred thousand (200,000) cubic feet per second.

(13) The company states that the volume of water leaving Kootenay lake is naturally limited by the cross sectional area of the Kootenay river channel at Grohman narrows, B.C., a point about two miles above Granite, B.C., and about two miles below Nelson, B.C., and therefore by enlarging the cross sectional area of said narrows a greater quantity of water would be allowed to pass at all stages of the lake level, making possible a lowering of the level of Kootenay lake and of Kootenay river at the international boundary line during the high water stages.

(14) The company proposes therefore, if the consent of the International Joint Commission is given to this application, to enlarge the cross sectional area of Grohman narrows by removing therefrom substantial amounts of rock, gravel and boulders which will permit of the discharge out of the lake of a larger quantity of water than under the present natural conditions, and will therefore tend to lower the high water at all stages above the storage line hereinafter mentioned.

(15) That the dam as constructed at Corra Linn will not increase the natural elevation of the waters in Kootenay lake or Kootenay river at the international boundary line at any stage above the storage line hereinafter mentioned, and then only when being operated to effect such storage under and pursuant to the consent now being sought from the International Joint Com-

mission. The said dam is constructed with sluice gates which will discharge a much greater flow of water than has ever been recorded in Kootenay river, it being possible to discharge through said sluice gates more than two hundred and fifty thousand (250,000) cubic feet per second when the elevation of the water in the fore bay of the Corra Linn dam is at seventeen hundred and forty-five (1745) Geodetic Survey of Canada Datum 1928 Adjustment.

(16) The company states that the dam at Corra Linn has been built of reinforced concrete on solid rock and is provided with motor operated sluice gates supported between massive reinforced concrete piers.

(17) The company desires, by the construction of the compensatory works already completed in the river and the compensatory work to be completed at Grohman narrows as above mentioned and by the operation of the said dam at Corra Linn to provide storage of approximately six feet of water above elevation 1739·32 the present average low water mark in Kootenay lake which is now the zero mark Geodetic Survey of Canada Datum 1928 Adjustment on the gauge at Nelson, B.C., which will assure the company of having approximately ten thousand four hundred (10,400) cubic feet of water per second flowing through its power plants on Kootenay river at Corra Linn and below during the low water period.

(18) The company proposes to effect said storage by partially closing the sluice gates in the said Corra Linn dam when the water of Kootenay lake reaches a stage of approximately four feet (4) above the said average low water mark at which level about twenty-three thousand seven hundred (23,700) cubic feet per second of water is flowing out of the river below Nelson and then allow the lake to slowly rise until it has reached the stage of six feet above said average low water mark, thus providing a storage in Kootenay lake of approximately six hundred and seventy-eight thousand four hundred and fifty (678,450) acre feet.

The storage at no time would be increased above the said six (6) feet above the said average low water mark, but will be reduced throughout the months of November, December, January, February and March as required to maintain an outflow from Kootenay lake throughout the said period of ten thousand four hundred (10,400) cubic feet per second and the said storage in any event will be all drained out to the said average low water mark at or about the end of March or when the waters of said river and lake commence to rise again as the result of the increase of water flowing into the said lake and river in the springtime, at which time the company would open the sluice gates of Corra Linn dam to allow all water to pass through the dam that would then be naturally flowing out of Kootenay lake, including the additional flow made possible by the compensatory works in the river above mentioned.

(19) That the effect of operating the said dam so as to create the said storage will be to maintain the level of Kootenay lake and Kootenay river at the international boundary line at a slightly higher stage during the low water period than it would naturally be in some years when the level would have otherwise receded to the average low water mark or below it.

(20) The company respectfully submits that the said works completed and proposed and the method of operation of the dam as proposed by the company will not have any injurious effect on any interests in the United States or any state thereof. Furthermore, the said proposed works and the operation of the said dam in the above mentioned manner will make it possible to decrease the high water levels at the international boundary line and beyond it, to the benefit of all interests in the United States and particularly to all interests in the State of Idaho, and is a benefit now being sought by said interests.

(21) That the following drawings and plans filed herewith* shall be read with and form a part of this application:—

F-2 General Plan of site of Corra Linn dam and Power Plant.

F-125 Plan of Kootenay River from west arm of Kootenay Lake to Corra Linn.

F-230 Profile of Kootenay River and Kootenay Lake from Corra Linn to Bonners Ferry, Idaho.

F-231 General Arrangement Power House and Dam at Corra Linn.

(22) That Appendix 1 of the Original Application for storage rights in Kootenay lake, dated 6th September, 1929, and now filed with the International Joint Commission, continue to be a part of this application as though incorporated herein.

Wherefore the undersigned hereby applies to the International Joint Commission for the approval of the said works and the plans thereof and of the construction of said works substantially in accordance with said plans and for the right to store in Kootenay lake and Kootenay river in the manner above mentioned six (6) feet of water above the elevation 1739·32 on the Nelson, British Columbia, Gauge, Geodetic Survey of Canada Datum 1928 Adjustment, being the elevation that has been taken as the average low water mark of Kootenay lake at the said city of Nelson.

Respectfully submitted,

R. C. CROWE,
Solicitor for West Kootenay Power and Light Company Limited.

Dated at Trail, B.C., this 8th day of February, 1932.

P

REPORT ON SOIL CONDITIONS IN KOOTENAY VALLEY, B.C., AND IDAHO, U.S.A.

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February 20, 1932

I. Introductory

1. Instructions, Origin of Data, Object of Report.—Instructions were received, on September 1, 1930, from Mr. J. S. Tempest, Commissioner of Irrigation, to accompany him to Kootenay valley, British Columbia, for the purpose of investigating the soil conditions in that area on both sides of the boundary, with special reference to the alkali content. These instructions were based on a letter from the Director, dated August 21, 1930.

The data for this report was obtained by an investigation made on the ground in what is known as the Kootenay Flats, extending from Bonner's Ferry,

*Copies of these drawings and plans are filed in the Offices of the Commission in Ottawa and Washington.

Idaho, to Kootenay Landing, British Columbia. In order to have a clearer understanding of the subject, careful consideration was given to the geology of the valley and to the origin of the alluvial deposits comprising the soils of the flats. Some of this geological information was obtained from Kirkland and Ellis "Geology and Ore Deposits of Boundary County, Idaho," issued by the Bureau of Mines and Geology, Moscow, Idaho; while the information regarding the formation of alluvial river deposits was adopted from Fraps' "Principles of Agricultural Chemistry." The remainder of the information, together with certain observations regarding geology, alluvial deposits, soil conditions, water table, alkali, detailed information on the districts, etc., are original.

The objects of the report are threefold—

(*a*) A study of the surface and sub-surface soil conditions of the area, with special reference to the identity and quantity of alkali salts present, if any.

(*b*) The effect of changes of water-table elevation on the movement of alkali salts, if present in the soil.

(*c*) The effect of (*a*) and (*b*) on the growth of crops.

2. Field Activities.—The field work commenced on September 14, 1930, and was finished on October 18, 1930. Four weeks were occupied in the field investigation.

The activities in the field were three in number:—

(*a*) Sixty-five groups of soil samples and six water samples were obtained. Fifty-six of the former and all of the latter were located in the eleven districts on the Idaho side of the boundary, while nine of the former were obtained on the British Columbia side.

(*b*) Thirty-one isolated soil samples, at varying depths from the surface to thirty-two feet were obtained. These were chosen, with the consent of the United States Geological Survey Engineers, from many samples preserved by them when the wells were sunk on the Idaho side.

(*c*) Inspection of general soil conditions in the valley was made in an attempt to correlate crop with soil conditions.

3. Office Activities.—

(*a*) Tests of the 364 soil samples and six water samples by means of the electric bridge, for alkali content. The results are given in Appendix 1.

(*b*) Chemical analysis of certain representative and critical samples. Twenty-two soil and three water samples were analyzed by the University of Alberta, while six soil and two water samples were analyzed by the Calgary City Chemist.

Thirty-three samples in all were analyzed.

(*c*) Preparation of the report. This includes a compilation and discussion of all collected physical and chemical data, together with the derived conclusions. It also includes a discussion of the soil conditions in each district. Appendices have been prepared dealing with the subject matter.

II. Geology

1. General Origin.—The portion of the Kootenay valley with which we are concerned lies between Bonner's Ferry, Idaho, and Kootenay lake, B.C., a distance of 30 miles in Idaho and 15 miles in British Columbia. This constitutes a portion of the Purcell Trench which was formed by faulting and subsequent glaciation of the area between the Selkirk and Purcell ranges. Its total length is over 300 miles, and it lies parallel to the Rocky mountains.

The alluvial soils of the valley originate principally in the neighbouring higher lands and masses. A study of these lands will therefore be included in this report.

2. General Topography.—Three types of topography are represented—

(a) Mountainous areas consisting of the Selkirk range up to 7,500 feet high on the west side; and the Purcell range up to 8,000 feet high on the east side of the valley.

(b) Plateau-like areas lower than the mountains, on the east side of the valley.

(c) Stream-Valley plain, occupied by the Kootenay river.

The higher areas mentioned in (a) and (b) consist of metamorphosed sediments, igneous rocks, etc., containing pure quartzites, argillaceous (clayey) quartzites, argillites and dolomites (principally carbonate of lime).

The area mentioned in (c) is occupied by lake bed sediments formed by erosion of the nearby higher masses, (a) and (b). They consist of silts, sands and gravels, and are dealt with in paragraph 3, following.

3. Kootenay Valley and Kootenay Lake.—Kootenay lake, the lower end of which is now 14 miles north of the Boundary, originally extended at least to a point five miles southwest of Bonner's Ferry near a former dam where Deep Creek emerges on the plain. Although the lake has varied in depth and altitude at various times owing to resistance of its dam and the fluctuations of its water supply, it had deposited stratified sediments to a depth of more than 200 feet in parts of the area. The highest level of this old lake was considerably above the 2200-foot contour above sea level; the valley and lake now lying at an elevation of about 1,750 feet above sea level. In its last stages Kootenay lake was dammed at a point five miles southwest of Bonner's Ferry. The lake preserved this extent until recent times. Conversion of its southern extremity (i.e. Kootenay lake to Bonner's Ferry) into a swamp probably has occurred only within the last few hundred years.

The sediments occupy the trench for a depth of at least 200 feet above bed rock. Some portions of the general trench are probably filled to a depth of 500 feet. The intrusion of Mission Hill in District 11 and two small hills in District 1 near Well 1-11 would appear to corroborate this data, as the bed rock cannot be very deep. Other lower hills probably exist which are covered by alluvial soil.

4. Reclamation Area Traversed by Kootenay River.—A more intimate study of the area susceptible of cultivation may now be made.

The Kootenay valley, which has an average width of three or four miles, is traversed by the Kootenay river which flows northward into Kootenay lake. It meanders along the valley with a total loss in elevation of about two feet in 75 miles or more of the river's length.

This flat hydraulic gradient causes the river to flow very slowly, although the discharge is surprisingly large owing to the depth and width of the river.

5. Formation of the Soils in the Valley.—

(a) *Original Movement.*—The soils filling the valley, which are alluvial in origin, may have had two sources, namely, from points higher up the river, and carried down by it, or, from the nearby terrain. The latter, being probably the most prolific source, will be considered for demonstration purposes, although both would originate in the mountain masses.

Streams from the mountains carry particles of soil into the river, which takes these particles and carries them along. In time of flood this burden becomes greater.

(*b*) *Deposition.*—Whenever the velocity of a stream is decreased it deposits a portion of its burden, *the heavier particles being deposited first.* Thus, when it spreads over the plain, it deposits a portion of the material on the surface of the plain. When a river in flood leaves its banks, the velocity is checked on spreading over the plain, and it deposits the coarser particles (fine gravel and coarse sand) near the channel of the river. The finer particles (fine sand, silt and clay) are carried farther, and are deposited in the swamps or low ground at some distance from the river. The tendency of a river under these conditions is to build its banks up above the rest of the plain. The fertile alluvial soils of the Kootenay were in this way gradually formed to a great depth.

(*c*) *Stratification.*—River deposits are stratified, i.e., the material is sorted and deposited in layers of nearly the same fineness. Fine gravel, sand of varying fineness, silt and clay will be deposited in this way. This sedimentation does not necessarily occur in a regular manner, but depends on the location of the river and subsidiary overflow channels in the valley.

Various stratifications have occurred in the Kootenay valley. Gravel, sand and silt deposits have been formed. Peat has been formed sometimes to a depth of three or four feet, from bulrushes, horsetail and other weeds and grasses. It is obvious that the deposition of strata will be irregular, forming ponds, marshes, " waves ", ridges, etc. The subsoil strata of gravel, sands, silts, and clays will also be irregular in extent and thickness. The extremes in elevation over the plain extend to a few feet only.

(*d*) *Present Cross-section of the Valley.*—A composite cross-section of the valley would appear as follows:—*

Thus it will be seen that the banks of the river are higher than the general elevation of the plain, while the overflow channels will be of a similar character, although not so prominent, for obvious reasons.

Owing to the conditions during the formation the ridges will theoretically be of a more or less sandy character while the areas near the mountains will be clayey, with silt between these extremes. However, in practice these conditions do not fully appertain owing to the frequency of overflow channels, bayous and other irregular features of the plain.

(*e*) *Changes after Deposition.*—The surface and subsurface soils to a depth of, say, five to eight feet, are changed after deposition because there is a tendency for the finer particles in the upper soils to be washed downwards by rain and other moisture. Thus the upper soils are often changed to a lighter character with a correspondingly opposite change in the subsoil. Some of these changes could occur after the recession of the lake.

The river is understood to be very deep, extending to ninety feet. It is quite possible that it has retained nearly the original bed and built up the surrounding land by flooding, as the velocity is not sufficiently great for scouring.

III. Soil Investigations

1. Field Work and Electrolytic Bridge Testing.—

(*a*) *Securing of Soil Samples.*—In making the soil investigations of this area, groups of soil samples were obtained at selected points by means of a 2-inch soil auger, which was more suitable than a soil tube on account of the moisture in the soil.

(*b*) *Depths.*—Samples were obtained as a rule at the following depths: A 0′-0′·5; B 0′·5-1′·5; C 1′·5-3′·0; D 3′·0-5′·0 and E 5′·0-7′·0. In two cases the writer obtained groups to a depth of 20 feet at suitable intervals.

* See diagram in original filed in the offices of the Commission.

Certain of these groups were preserved in pint glass jars for possible future chemical analysis. The remainder were preserved in paper bags for bridge testing only.

Notes were taken of conditions appertaining to the particular location and of salient points appertaining to each of these groups.

(c) *Bridge Testing.*—All of the samples were subjected to tests for alkali-content by means of the electrolytic bridge, which measures the ohms resistance of the wet soil. The so-called alkali salts consist of $Ca\ SO_4$ and in much less quantities, $Na_2\ SO_4$, $Mg.\ SO_4$ and certain other salts. These are detailed in Appendix 8b. This test is carried on in the field, or later, in the office.

A parenthetical note might be made here to the effect that the amount of water added to the soil for bridge testing controls the concentration of salts in the tested sample. Divergence from results by chemical analysis may occur under these conditions.

The table used for determining the percentage of alkali present when testing with the electrolytic bridge is as follows:—

Less than 80 ohms; very strong alkali, probably greater than 1 per cent.

Between 80 and 130 ohms; strong alkali, probably 0·6 per cent to 1 per cent.

Between 130 and 190 ohms; moderately strong alkali probably 0·4 per cent to 0·6 per cent.

Between 190 and 400 ohms; weak alkali, probably less than 0·4 per cent.

Above 400 ohms; negligible.

The results of these tests were indicated on the maps according to the following legend, the information being conveyed by means of a horizontally-divided circle about three-eights inch in diameter:—

Very strong alkali greater than 1 per cent.
Strong alkali 0·6 per cent to 1 per cent.
Moderate strong alkali 0·4 per cent to 0·6 per cent.
Weak alkali less than 0·4 per cent.
Negligible.

Note.—The symbols for the above amounts of alkali may be obtained from the original report in the offices of the Commission.

The results of bridge-testing are contained in Appendices 1 and 2. A discussion of results will be found under the various districts.

2. Office Work, including Chemical Analysis—

(a) *Nature of Work.*—The office work in the examination of samples was performed in the laboratory. It consisted of chemical analysis of a number of chosen samples which had already been tested by means of the electrolytic bridge, a study of the analytic data and comparison with bridge results.

(b) *Reason for Chemical Analysis.*—Soil testing by means of the Electrolytic Bridge is not sufficiently accurate for investigations of this nature without definite corroboration by chemical analysis. The bridge is essentially a field instrument and yields more or less rough results. In the area under discussion the problem was further complicated by the presence of peat, humus or calcium carbonate, all of which increase the resistance of the bridge, and consequently might produce results which were erroneous and at variance with the chemical analysis.

It was found, incidentally, that peat and $Ca\ CO_3$ do not occur together to any great extent.

(c) *Choice of Samples for Chemical Analysis.*—The samples for chemical analysis were chosen after an examination had been made of the bridge results and of the nature of the soils themselves. Only those samples which appeared, by a study of bridge results. to contain the greatest amount of alkali, were included.

Consequently one or two samples of certain groups were chosen for this purpose.

Instructions were received from Ottawa that 25 samples of the 133 preserved in glass jars were to be chemically analysed. Great care was therefore taken in the choice of samples.

(d) *Origin of Chemist's Data.*—Twenty-two soil and three water samples were analysed by Dr. Wyatt of the University of Alberta. On receipt of these results an additional set of six soil and two water samples were analysed by the Calgary City Chemist for more complete corroboration.

The results were entered on the 16 sheets included in Appendix 8a.

(e) *Nature of Chemist's data and its application.*—Chemical analyses were made of these 28 typical soil samples and five water samples to ascertain the precise nature and amount of the bases—Lime (CaO), Magnesia (Mg O) and Alkalis (Na_2 O); and acid radicals—Sulphates (S O_3), chlorides (Cl) and Carbonates (C O_2); contained in the total salts. These bases and acid radicals shown in Appendix 8a have been combined by a method based on the Atomic Theory to ascertain the identity of the salts contained in the various samples.

A full list of these analyses is shown in Appendix 8b.

(f) *Interpretation of Chemical Analysis.*—In Appendix 8b, columns c, d, e and f, are shown the results of segregation of salts as derived from the chemist's analysis. Before examining these results a brief discussion of the relation between bridge results and chemical analysis is necessary.

All of the samples chosen for analysis, except 27 A skim and 29 A skim tested "weak" or "negligible" on the bridge. These two exceptions were "skim" samples and of very rare occurrence. Explanation of the "skim" samples from "hoarfrost" alkali soil will be found in III, 4. e and in III 6. District 1.

As a starting point in the discussion it was decided to average the results. The samples were found to contain the following average amounts of the various salts, according to the data contained in Appendix 8b:—

(c) Sodium sulphate Na_2 S O_4.. ..	·055	grams per 100 grams soil
(d) Calcium sulphate Ca S O_4.. ..	·230	"
(e) Magnesium sulphate Mg_5S O_4..	·037	"
(f) $CaCl_2$, Mg Cl_2, Ca (H $CO_3)_2$, Mg (H $CO_3)_2$, Na Cl..	·071	"
(g) Total salts by addition..	·386	"
(h) Total salts less $CaSO_4$..	·163	"
(i) Solids after ignition..	·371	"
(j) Average Ohms Resistance..	·347	"
(k) Per cent Salts from Bridge Table.	·073	"

This numerical analysis indicates the small average amount of total salts (0·39 per cent) and the average of total salts less Ca SO_4 (0·163 per cent). The calcium sulphate is eliminated because it is comparatively innocuous, being only 0·2 per cent soluble as compared with 40 per cent in the case of sodium and magnesium sulphates. It is to be noted that these percentages are probably the maxima to be found anywhere in the valley,

as the samples chosen for analysis were those which indicated the highest percentages by bridge test. The average alkali content of any number of samples chosen indiscriminately throughout the valley would therefore logically be less than the amounts quoted above. The results of analyses will be discussed in detail under the districts from which the samples were obtained.

Of the 28 soil samples which were analysed, 18 samples contained less than the average of toxic salts (0·163 per cent); 21 samples contained less than 0·200 per cent; and 26 samples contained less than 0·400 per cent. Only one sample—26 C—contained 0·500 per cent.

Sample 26 is in the centre of the soil column of Group 26, of which the remaining samples contained about 0·1 per cent. It is therefore probable that this particular sample contained a small extra concentration of salt not shown in the bridge test. A considerable length of time usually elapses between the taking and testing of a sample and its chemical analysis, and repeat samples cannot be obtained owing to distance. In this case the bridge indicated a "weak" amount. Therefore, reasons for any departure from the average must be deduced if possible. The bridge test did not indicate much difference in content. As before mentioned, infallibility is not claimed for the bridge. The results may not be absolutely accurate but form a fair guide when all samples cannot be chemically analysed. Appendix 8b, columns (*h*) and (*k*), contain the total salts less $Ca\ SO_4$ and the percentages of salts from the bridge table, respectively. Appendix 8c contains the same data in graphical form.

An alkali content (less $Ca\ SO_4$) of 0·5 per cent is not a large amount in itself as even wheat will withstand 0·7 per cent, and when considered as a single sample of a large number of samples, it fades into insignificance in any argument.

Soils are by no means homogeneous, and a small concentration of alkali might very readily be located in a single sample. There is obviously a limit to the arguments that can be based on the results of analysing the contents of a hole $\frac{3}{4}$-inch in diameter from a field of many acres, whether by bridge or chemical analysis. However, the balance of evidence is greatly in favour of the statement, that this is a very unusual and infrequent occurrence, particularly as the chosen samples for analysis apparently contained the most alkali, judging from the bridge tests.

The results of analysis of the water samples indicate that they are practically free from alkali. It is obvious that if alkali were present to any extent it would be found in the water samples which were obtained at strategic points.

(*g*) *Dr. Wyatt's Report on his own Analysis.*—In order to corroborate the statements made above, the report of the chemist is desirable. In his report Dr. Wyatt stated that "The total salts present in the samples were of a low order in all cases. From these results it would seem that the present conditions would indicate no detrimental results from the alkali salts with the one exception of the skim sample in group 27 (this has already been explained). The soluble carbonates in all cases were present only in small quantities and only in bi-carbonate form, as indicated by the reaction (Ph values), as well as by the fact that in no case were normal carbonates indicated during the process of titration when phenylphthalein was used. Of the results (salts) actually found, by far the greater portion consisted of sulphate of calcium and showed very small quantities of sodium salts. The calcium sulphate salts are not nearly as toxic as the sodium

salts, and they did not show up in a bridge test to the same extent as do the sodium salts. For this reason the bridge test indicated less salts than are actually found in the soil. However, *the bridge test* under such conditions *would give a fair idea* of the toxic condition of the soils. It is just possible that the toxic conditions of the peat samples are less serious than is indicated by the bridge test."

(*h*) *Limit of Tolerance or Toxicity.*—Dr. Shutt of the Central Experimental Farm, Ottawa, formulated certain rules for guidance of the Dominion Irrigation Branch regarding the allowable limit of alkali salts present in soils in the growth of plants under irrigation. They are quoted at this point in order that an idea might be formed of the action of alkali on plants. These rules were formulated after a correspondence with several eminent United States agriculturists. The rules were as follows:—

"Land may not be used for irrigation if A (0-0′ ·5) tests less than 190 ohms, and B sample (0′ ·5-1′ ·5) less than 130 ohms." Samples lower than 1·5 feet are apparently not limited in content, as they are not mentioned under the rules.

(*i*) *Calcium Carbonate.*—The presence of $CaCO_3$ was roughly indicated by means of a commercial solution of hydrochloric acid applied to the wet soil. The amount of effervescence is roughly indicative of its prevalence. This salt is practically insoluble in water and is consequently harmless to plants, but it affects the bridge results.

The legend used on the maps (appendix 6) is as follows:—

"No $CaCO_3$" indicates no reaction.
"Ca CO_3"—small reaction.
"Ca CO_3" average reaction.
"Ca CO_3"+strong reaction.

(*j*) *Class of Material.*—Each sample was classified by field observation only, according to the nomenclature of the U.S. Bureau of Soils. Appendix 7 gives details of the standard.

3. Effect of Height of Water-Table on Growth of Plants.—

(*a*) *Proposals of the West Kootenay Power and Light Co.*—The proposals are understood to include the storage of water to a total extra depth of six feet beginning about September 1 to 15. This storage continues until approximately January 1. Withdrawal of this stored water then begins and continues until March when the amount withdrawn equals the flow of the river. The gates are then opened and the water lowers through the summer faster than under natural conditions.

(*b*) *Effect of Proposal.*—Under these proposals, the water-table in the area should lower more quickly than under natural conditions due to greater hydraulic head, provided water seeps into the river from the land. The plant life certainly needs water during the early periods of growth; and the water table should be very low long before the period of maturity, under these proposals. The water table can be controlled in the districts as at present. The headgates of District 6 are understood to have been shut during the autumn of 1930 even after the river became lower. Apparently this was done in order to conserve the water table for use in maturing the crop. This would appear to indicate that the farmers themselves know the value of the water table, particularly during dry years.

(*c*) *Authorities as to the Permissible Height.*—Reliable authorities are very careful and rightly so, in committing themselves on this point. They

qualify their statements by certain conditions. They state that the necessary depth varies with the types of soil and plants, and consequent root system. However, several agriculturists both in Canada and the United States advanced opinions at the request of the writer. All available evidence is hereinafter quoted.

Domestic Opinions

The writer spent two weeks inspecting the Bedford Levels and the Pevensey Levels, in the east and south portions, respectively, of England, in 1919, in company with the respective superintendents. Thousands of acres in these areas were being used for agriculture, mainly grazing, if memory serves. The water table was only a foot or so beneath the *level* surface. The land was so low and the water so high that the fall of the tides was depended upon for drainage from the canals by means of gates. The drainage ditches possessed absolutely no fall for miles, depending on hydraulic head alone for discharge.

W. L. Jacobson and W. H. Snelson, formerly of this branch, are considered to be authorities, particularly the latter. Mr. Snelson is quoted by U. S. Agriculturists regarding many phases of his research work.

Mr. Jacobson states that "shallow rooted plants, such as pasture grasses and clovers, may be grown with the water level at three feet, while for a deep rooted plant such as alfalfa, the water level should be not nearer than five feet. In general, it may be safely stated that for most crops under average soil conditions any existing water-table need not be maintained lower than four feet below the ground surface."

Mr. Snelson states that he carried on a series of investigations on the Dominion Government Irrigation Plots at Strathmore, Alberta, in 1915 by means of wells in certain irrigated plots where the water-table was often only 2 feet from the surface at certain times during the growing season.

Kootenay Valley itself may also be cited as an instance of good crops being produced when the water-table rises to a point near the surface. During the present investigation, September 14 to October 18, 1930, water-table was found at the following depths at points which produced good crops:—

Group	Depth of W.T.	Group	Depth of W.T.
12	5·5	60	5·2
26	4·8	59	5·0
28	3·7	57	6·5
48	2·6	41	7·0
49	6·3	40	7·4
21	7·0	37	6·8
47	3·0	53	3·3
54	5·4	20	4·9
29	3·7		

It is to be noted that these depths were obtained in October, after the water table had presumably fallen during the growing season, and after the crops had been harvested.

Foreign Opinions

The opinions of two United States authorities were requested on this question. These were Prof. F. J. Veihmeyer of the College of Agriculture, University of California, Davis, California, and W. G. Sloan, Consulting Agricultural Scientist, of Boise, Idaho.

Prof. Veihmeyer after citing several authorities, states:—

> "I think it would be safe to conclude that, in general, four feet of soil above a water-table would be satisfactory for field and truck crops and at least six feet for deciduous trees."

Mr. Sloan states that in his opinion the safe minimum distance from the ground surface to ground water is dependent on the following major factors:—

Capillary power of soil.
Uniformity of soil structure from surface to ground water.
Character and amount of alkali salts in soil and water.
The period of time during which ground water remains within capillary distance of the surface.

He states that "a four-foot depth might be safe for a short period of years but for permanent safety not less than six feet should be considered. The gradual accumulation of alkali from a water table four feet from the surface may be almost imperceptible from year to year but over a period of from fifteen to twenty years it is quite liable to become so serious as to destroy the value of the land for general farming. If diversified farming is practised, the water-table must be kept low enough for the deepest rooted crops."

It might be noted, however, that the results of this investigation indicate that alkali is not present in the Kootenay valley in harmful quantities and, therefore, the danger of a gradual accumulation of alkali from a water table near the surface, as stated by Mr. Sloan, is not particularly applicable to lands in the Kootenay valley.

Mr. Sloan enumerates the following references on "The Safe Minimum Depth to Water-Table in Irrigated Crops."

"*Irrigation Engineering*" by Davis and Wilson, 7th Edition, John Wiley & Sons, New York. Page 195, para. 5.

"*Drainage and Flood Control Engineering*" by G. W. Pickels, 1st Edition, 1925, McGraw-Hill Book Co., New York. Page 219.

"*Land Drainage and Flood Protection*" by Etcheverry, 1st Edition, 1931, McGraw-Hill Book Co., New York. Page 30.

"*Control of Water*" by P. A. M. Parker, 1925, Geo. Routledge & Sons, Ltd., London. Page 748.

The first two books are in the library of this Bureau, the third is absent and the fourth is present in its 1913 edition.

Davis and Wilson state that the ground water on irrigated land should be kept five feet or more below the surface of the ground.

Pickels differentiates between irrigated and arid soils. He states that the drains, or, in this case, water table should be lower in arid soils than in irrigated soils and that, in irrigated soils, the minimum depth of drains should be six feet. It is to be remembered that the efficiency of drains decreases laterally, and depends on their distances apart. The relief depth would therefore be less than six feet midway between them.

Parker gives several illustrations and opinions, varying from one to six feet.

F. H. Burkitt, of India, in a note to the Central Board of Irrigation at New Delhi, India, dated June 20, 1931, and contained in the "Digests of Technical Notes, 1931," states in paragraph 41 of "Water Logging and Reclamation" as follows:—

> "Provided that the subsoil water is kept moving, a high water-table will not sour the land and good crops can be grown even where the water-table is only a couple of feet below the surface."

This publication is on File 1195-W.—21 R.S. in the Ottawa Office of the Dominion Water Power and Hydrometric Bureau, under date February 13, 1932.

"*Principles of Agricultural Chemistry*" by G. S. Fraps. The Chemical Publishing Co., Easton, Pa., contains some very interesting data on this subject in pages 101 to 105, which corroborate the above observations.

4. Kootenay Valley in British Columbia.—

This constitutes the Canadian portion of the valley. One reclamation scheme has been constructed at the south end. Indian Reserves form a large portion of the remainder.

The soil conditions in the Valley, on both sides of the boundary, do not differ materially. They will be treated separately, however, for National reasons.

(*a*) *Soil Conditions.*—Nine groups of soil samples, viz., 1, 2, 3, 4, 5, 6, 7, 24, and 25, as detailed in Appendix 2, were obtained on the Canadian side to a depth of 7 feet. The groups were obtained at widely divergent and typical points although all were located comparatively near the river in order to use it as a datum for levels, no topography maps of the Canadian side being available. Profiles were run to the river in each case. (See Appendix 3).

(*b*) *Water-table.*—The whole Canadian valley possesses a water-table which lies at varying depths from the surface depending on the nature of the subsoil, time of year and location in the valley.

In groups 1, 2, 3, 5, 6, 7 and 25 the water was found to be less than seven feet below the surface. No water was found in Groups 4 and 24 at a depth of seven feet. (See Appendix 3).

The elevation of the water-table in the valley appears to be related, in part at least to the elevation of the river surface, which may vary eighteen or twenty feet during the year. Any relation which may exist between the water-table and the river can be ascertained only by wells. The water-table is apparently highest in the spring but lowers during the summer. If there be any seepage along the toe of the mountain slopes then the water-table would certainly be augmented from this source. The comparative amount of water added by the river and by seepage, to the water-table was not ascertained by the writer. The water-table in Groups 1, 2, 3 and 25 was higher than the river surface; that in 5, 6 and 7 was the same, or lower. No water was found in Groups 4 and 24 to the 7-foot depth. This has reference to the Canadian side. The rate of fall of the water-table will depend on the class of material, providing that much actual seepage occurs both into the river when the water is low, and into the land when the river is high. Valuable information might be obtained if both banks of the river from Bonners Ferry to Kootenay lake were examined after the spring flood, i.e., when the water is falling, from a launch, to ascertain the amount of water, if any, which is seeping from the land to the river. This should be done soon after the river has begun to lower.

Any opposite movement during flood would need to be ascertained by means of wells immediately under the river banks.

This report is accompanied by Appendix 3, which shows the profile of the surface at each group, and the depth of water-table if found at less than seven feet.

(*c*) *Type of Soil.*—For general purposes throughout this report the soil, both on the Canadian and the American side, is divided into two depths, 0′·0-3′·0, and 3′·0-7′·0. The type of soil was found by examination of the soil groups, to change very little from south to north. However, a map showing the location of groups obtained, Appendix 4 which accompanies this report, indicates that it is slightly heavier near the Kootenay lake than at the boundary, i.e., more silt and clay are present in the north, and more sand near the boundary. In other words, the finer particles are slightly more prevalent in the north. It is also noted that the soil becomes heavier from the surface down the soil column. Appendix 2, column 10, contains this information in detail. The basis of soil classification is shown in Appendix 7.

(*d*) *Peat.*—Undoubtedly a considerable amount of peat will be found in the pools and marshes at a distance from the river. This is indicated by the presence of numerous large areas of bulrushes, horsetail and other vegetation. However, all of the groups were obtained within 400 to 800 feet of the river. In consequence, only one group, No. 3, was obtained with an appreciable amount of peat. Three other groups 4, 24 and 25, contained a small amount of peat on the surface.

(*e*) *Alkali Content by Bridge Tests.*—Nine groups, viz., 1, 2, 3, 4, 5, 6, 7, 24 and 25, were obtained on the Canadian side. Groups 1 and 2, only, contained more than a negligible amount of alkali, and that in the first few inches. The remaining samples tested negligible to the depth of seven feet. "Hoar-frost" alkali, hereinbefore described, was found at Groups 1 and 2, on the Canadian side. Only the first quarter-inch tested unfavourably, the soil being alkali-free beneath. The areas are circumscribed in extent, being from 200 feet diameter upward.

In the opinion of the writer this small concentration on the surface contains the whole of the alkali present in the soil column, at least to the limit of capillarity. There may have been a small amount present in the soil column above the general water-table.

The constant vertical movement of the water-table would dissolve all of the alkali it could reach except the upper few feet which would only occasionally be reached by the water.

The majority of the salts would thus be leached out and taken away by drainage during past ages. Capillary attraction will cause water to rise sixteen inches in coarse sand and four feet in silt or clay. In Kootenay Flats the highest limit would vary from three to four feet. It could therefore easily act in the space between the surface of the ground and the level of the water-table.

Results from Groups 1 and 2 would indicate that only the first quarter-inch contains an appreciable amount of alkali as the test of Sample "A" in each case indicated a negligible amount. It still continued to decrease to a depth of seven feet.

The remaining groups indicate a negligible amount of alkali throughout the soil column, without exception. As a general rule the amount of alkali consistently decreased with the depth.

If no alkali be present to a depth of seven feet (with the above exception) with the water-table rising near the surface during some portion of the year at least, it is logical to believe that no alkali is present to any

appreciable extent in any portion of the soil column, especially as some wells were tested to a depth of 30 feet to 40 feet with a negligible result. These general remarks apply to the Idaho side, as well as the Canadian side of the boundary.

(*f*) *Effect of Water Table on Vegetation.*—With the exception of the reclaimed area the whole surface of the Canadian valley is covered with a heavy growth of many different kinds of water grasses and weeds, such as horsetail, bulrushes, cat-tail, etc., much of which is cut by the Indians for hay. The reclaimed area yielded a good crop of wheat.

Shallow-rooted plants may be grown with the water-table level at 3·0 feet, while for a deep-rooted plant the water-table should not be less than 5 feet. In general, the water-table should be maintained at not less than four feet below the surface. This has already been fully discussed in III, 3 c. and III, 4 v.

(*g*) *Alkali Content by Chemical Analysis.*—No Canadian samples were chemically analyzed as the Idaho data applies on both sides of the boundary.

5. Kootenay Valley in Idaho.—

A large portion of the valley from the boundary to Bonner's Ferry has been reclaimed by means of dykes. Eleven districts have been formed to date. The number and size of the districts were determined by the creeks issuing from the mountains.

Accurate and detailed topographical maps had been prepared by the United States Geological Survey. The locations of some three hundred wells which had been sunk were indicated on these maps which are included in Appendix 6. The elevations of the tops of the pipes being known, this information was used to ascertain the elevation of ground surface, water-table, etc., in connection with the soil samples. The United States elevation datum is understood to be 0·2 feet lower than the Canadian datum.

It might be mentioned here that some areas of peaty soil have been burned inadvertently, thus losing a foot of elevation. Most areas lose elevation by cultivation, as much as a foot being noted, by comparison of new level with those on the topographical maps.

Fifty-four groups of soil samples were obtained from this area, each to a depth of seven feet, and two more groups, 18 and 26, to a depth of twenty feet. In addition to these fifty-six groups, thirty-one miscellaneous samples were obtained from the spoil of the wells sunk by the United States Geological Survey, the samples having been preserved by them. Six samples of free water were secured from the Kootenay river, drainage ditches and certain ponds.

These samples, 323 in all, were tested for alkali content by means of the electrolytic bridge.

Appendix 6 consists of copies of the nine United States Geological Survey maps on which have been placed condensed information connected with each group, each of which is correctly located thereon. The information is as follows:—

(*a*) *Elevation of water-table at nearest well.*—The water-table at the sample, if within reach of the seven-foot soil auger, was obtained, but the nearest well supplied this information more accurately and quickly as considerable time was required for the water to reach its correct elevation in the group hole.

(*b*) *Degree of concentration of alkali.*—This data, having been determined by the bridge, is entered on the maps in accordance with the legend described in III (1) (c).

(*c*) Average class of material of the first three feet and of the next four feet, and to a further depth if obtained. In appendix 2 a rough idea of the class of material of each sample is indicated, this information being gained by observation only, as no physical analysis was available. This is described in III (2) (i).

(*d*) A rough estimate of Ca CO_3 present as described in III (2) (h). Each district will be treated separately in this report.

District 1

This District lies on the west side of the river as shown on Maps Nos. 7 and 8, Appendix VI.

Eleven groups, viz: 12, 11, 10, 8, 16, 27, 13, 15, 14, 17 and 28, were obtained in this District to a depth of seven feet, and two groups, 26 and 18, to a depth of twenty feet. In addition samples were chosen (Group 19), from the spoil bank of Recording Well No. 1, near well 1-52, which is probably about fifteen feet deep.

More deep samples would have been taken if the writer had not been indirectly warned by a United States Geological Survey engineer of the possibility of starting an artesian effect and thus causing damage to property. His informant stated that " one man in the valley had been apprehensive of results of sinking wells which might cause floods and subsequent damage."

Location of Groups.—An attempt was made to obtain a general north and south cross-section to include flat lands and ridges.

Groups 8, 10, 12, 13, 14, 18, 26 and 28 were obtained on flat areas.

Groups 15 and 17 were obtained on ridges on the sides of overflow channels.

Group 11 was obtained to ascertain if possible the reason for failure of wheat to grow in an area five feet in diameter, at request of Mr. Matthews.

Group 16 was obtained, by request, in the centre of an area which produced 3,000 pounds of peas per acre, a very large yield.

Group 27, was obtained by request at a point 30 feet northeast of Group 10 in order to study the reason for appearance of hoar-frost alkali on the surface.

Group 19 was obtained from the spoil bank of Recording Well No. 1 in order that the lower depths for alkali-content might be tested and to ascertain the class of material.

Class of Material.—A study of the information gathered in the groups indicates that the surface soil in the flatter areas with a general elevation of 1748 to 1754 varies from fine sandy loam to silt loam. In fact the soil is very light and " fluffy " for the first few inches in some areas, partly due to the presence of humus. The next four feet consist of fine sand, coarse sand, or silt loam. Very little clay or clay loam is in evidence.

Clay loam and blue clay with strata of sand and sandy clay extend to at least 30 feet. Brown and red and green streaks were also noted, which is to be expected, considering the origin of the soil. The log of the wells which were made by the labourers who sunk the wells, appear to substantiate the statement that the sand, silt and clay exist in more or less distinct layers.

The soil in general appears to be heavier at the sides of the valley than in the centre.

Two groups, 15 and 17, were obtained on the ridges on the sides of the overflow channels. These overflow channels together with the two contiguous ridges are indicated on the map, appendix 6, sheet 7, by close rows of contour lines meandering through the flats.

These ridges appear to consist of silt-loam, loam and sand; in other words, of a lighter soil than that on the flats. This condition substantiates the general theory.

Alkali Content of the Soil by Bridge Tests.—Fourteen groups were obtained in District 1. Groups 8, 11, 13, 15, 16, 17 and 19 indicated a negligible amount of alkali in the soil column to a depth of at least seven feet. Groups 10, 27 and 28 tested "strong" in the "skim" sample only, that in the remainder of the soil column being negligible. Group 26 tested weak to 3 feet, then negligible. Group 14 tested very weak (nearly 400 ohms) to 0·5 feet, then negligible. Group 18 tested very weak (nearly 400 ohms) to 0·5 feet then negligible to at least 20 feet.

Even the very small amount of alkali present consistently decreased with the depth. The results of testing the "skim" sample could alone form the basis for possible argument regarding injury to crops.

If any larger quantity of soil were taken than a bare quarter of an inch it would be seen that not sufficient alkali would be present in a reasonable soil column, say one inch or two inches, to be noted by the bridge. Moreover, the areas from which these samples were taken did not indicate any crop injury whatsoever. On the whole, injury to crops appears to be very unlikely when such a small amount of alkali has risen to the upper three feet during all of the centuries by means of movement of water-table and capillarity, especially when the soil column to a depth of thirty feet or more contains little or no injurious salt. The tests from United States Geological Survey Samples 1 to 31 to a depth of thirty feet or more prove this statement.

In District 1, Samples 26A, 26B, 26C, 26D, 26H, 27A skim, 27A and 27E were analysed. Samples 26A and 26C were first analysed by Dr. Wyatt. He found a total salt content of 0·7 per cent in 26C. Samples 26B, 26D and 26H were afterwards analysed by the Calgary City Chemist to find an explanation for the apparent high content. This condition has been discussed and it has been shown that the general conclusions are not affected by the results. The same is true in the case of "27A skim."

Alkali Content by Chemical Analysis (Appendix 8b).—Appendix 8b, column K, contains the percentages of salts according to a bridge table in Bulletin 61, U.S.D.A., in possession of the writer. Comparison of k and h proves interesting. The ohms resistance of 26A, 26B and 26C were nearly identical. This similarity did not occur in the chemical analysis and is shown graphically in Appendix 8c.

The Carbonates.—The silts appear to contain more of the carbonates than the clays. The peats do not contain any carbonates. These carbonates affect the bridge, i.e. the bridge is not so accurate in their presence.

Peat.—Only a small amount of silty peat is present in this district and that to a depth of a few inches only. In fact this should be called humus owing to the amount of soil with which it is mixed. Peat also acts adversely in the accuracy of the bridge and on account of its presence in the soil it is advisable to corroborate the bridge results by chemical analysis. This is illustrated by Groups 21, 54 and 59, noted in Appendix 1.

Water Table.—The water table at the nearest wells to the various groups was ascertained when the groups were obtained; but, as they are isolated elevations taken indiscriminately this information cannot be correlated in any general way. Mr. Matthews deals exhaustively with this phase.

The elevations varied from 47·61 in 1-32, where the ground surface elevation is 53·99 to 36·90 in 1-43 with a ground elevation of 49·51. The nearest approach of the water table to the ground surface is at G. 28 near 1-32 where its depth was 3·7 feet. The elevation of the water in the Kootenay river would be about 43·0 on October 6, 1930.

Seepage.—Seepage was noted at the toe of the mountain slopes. This augments the volume of water in the flat. It is possible that this water comes directly from the hills, although the writer's assistant—a casual helper who is a B.Sc. graduate of Oregon University and a mining engineer with a fairly complete knowledge of the geology of this area stated his belief in a false bedrock fifty or one hundred feet below the surface of the flat. He thought that this false bedrock with its superincumbent soil exerted a pressure on the strata and water between that point and true bedrock which caused the water—the purest he ever knew—to gush out on the sides of the flat. This theory is given for what it is worth. Undoubtedly the seepage water is present and is added to the general water table. It might be noted that at the time of visit seepage water was flowing from a small hole in the north side of the road a few hundred feet west of 1-13. Another peculiar fact noted was that while the water table in well 1-12 was 3·37 feet below the surface of the ground, that in an extra well five feet east of 1-12 was 11·2. This would seem to indicate an artesian effect in the well. A " blow-hole " existed near the drain directly west of 1-8 and another one in the drain a few hundred feet west of 1-31. The artesian effect at these points decreases as the season advances. The artesian effect indicates either that the source of the water is higher in the hills or that pressure from below is exerted on it.

District 3

This is a small district lying on the west side of the river as shown on Map No. 6, Appendix VI. Soil groups Nos. 48 and 49 were obtained and tested. Group No. 48 was located in the slough and Group No. 49 in the upper lands. These two groups were typical of the district.

Soil.—The slough consists of peat to a depth of one foot. From this point to five feet a considerable amount of silt and clay are mixed with the peat. Silty-clay loam then exists to at least seven feet. In the uplands the soil consists of peat to a depth of 1·5 feet with silty peat to 3 feet. Clay loam then exists to at least 7·0 feet. Thus the soils of the uplands are lighter than those of the slough in the lower depths.

Alkali Content, by Bridge Tests.—The bridge tests indicate that a very small amount of alkali, probably about 0·2 per cent, exists in the uplands to a depth of 3·0 feet and still less in the slough to a depth of 1·5 feet. The amount of alkali below 3·0 feet is negligible, and becomes less as one goes downward. No carbonates appear to be present.

Alkali Content by Chemical Analysis.—As the bridge tests indicated "weak" or "negligible" no samples from District 3 were analysed.

Water Table.—The ground level in the slough is about 53·5. The water table is about 51·5, which would be about 8·0 feet above low water level in the river and 2·0 feet below the surface of the slough.

District 4

District 4 lies on the east side of the river and has a large area. It is shown on Maps 3 and 5, Appendix VI.

Soil.—Groups Nos. 9, 21, 43, 44, 45, 46 and 47 were obtained, all to a depth of 7·0 feet. No. 9 was in the drainage ditch near No. 47. From the south end of the district to about Well 4-134 the soil consists of loam for three feet with a sub-soil of silt loam. The soil to the north of this well and below contour 57

consists largely of peat to a depth of from 3 to 5 feet. In all cases except the first foot the peat is mixed with more or less silt. The soil below 4 or 5 feet consists of clay loam or silty clay loam. The silt and clay come nearer the surface in the northern end, in fact very little peat is evident, as is the case over the whole district above contour 57, approximately.

Alkali Content by Bridge Tests.—Groups Nos. 43, 44, 45 and 46 contain a negligible amount of alkali to a depth of seven feet. One group, 21, contained a weak amount only in B, C, and D. Group 47 obtained in a peat bed, contained a moderately strong amount—about 0·4 per cent—in the first eighth-inch (47A Skim). No alkali crust appeared on the surface, but on the inside of the drainage ditch, seventy feet to the west of Group 47, was found what was apparently a thin crust of crystals. Group 9, a single sample, was obtained at this time in the ditch. Group 47 was afterwards obtained for corroboration.

The percentage of alkali in both Group 9 and Sample " 49A Skim " depended upon the amount of soil taken. Sample 49A appeared to contain a weak amount. Below this none was indicated. This matter of " hoar-frost " alkali has already been discussed.

The carbonates are almost entirely absent because of the prevalence of peat and clay.

Alkali Content by Chemical Analysis.—Samples 21C, 21D, and 21E were analysed. The results generally corroborated the bridge tests. Sample 21D contained 0·577 per cent of total salts, but the most of this was $CaSO_4$ which is harmless. The salt content of the rest was found to be very small.

Water Table.—In the south the water table is very low, being 42·88, about the level of the river. Over the rest of the district it is much higher, being as high as within 2′·5 to 3′·0 below the surface. Near the north end it is about 6′·5.

District 5

This is another small district lying on the east side of the river as shown on Map 6, Appendix VI, and consisting of a few hundred acres only. Soil groups Nos. 54 and 55 were obtained and tested. These were located on average soil.

Soil.—The soil below contour 60 consists of peaty loam and clayey peat in the first three feet. Below 3 feet it consists of silty clay loam. Above contour 60 and on the west side the soil is lighter. Little or no carbonate is present.

Groups 54 and 55 were obtained in what could be considered the most likely locations for possible alkali concentration, viz: the flat below contour 57·0. Originally this area would probably be sloughy as indicated by the location and the peaty silt which is at least 3 feet deep.

Alkali Content by Bridge Tests.—Tests of the soil in both groups to the depth of seven feet indicated a weak amount of alkali, probably about 0·2 per cent. This condition extended to the full depth of seven feet. The soil below seven feet is apparently similar to the soil in other districts.

Alkali Content by Chemical Analysis.—Samples 54A, B, C, D, and 54E were analysed. Reference to Appendix 8b will indicate that, although the total salt content varied from 0·728 per cent to 0·317 per cent, $CaCO_4$, formed the principal portion. The amount of Na_2SO_4 was very small. Hence no harm can result from the alkali content of this soil.

Water Table.—The elevation of the water-table in this district lay at about 50·0 on October 14, i.e., 6·5 feet below the surface of the ground in the lowest portion of the area.

District 6

This is one of the largest districts and lies on the east side of the river as shown on Map No. 1, 2, 3, and 4 in Appendix VI.

Groups Nos. 22, 23, 32, 33, 34, 35, and 36 were obtained in widely divergent locations. A large portion of the area was inspected in a general way.

Soil.—The soil in District 6 is of a slightly heavier consistency than is usual in the valley. More clay and less silt was found. The clay frequently approaches the surface over a large portion. It is prevalent over the northern portion bounded on the north by wells 6-179, 6-189, 6-201, and 6-202. This division is very roughly indicated, as an exact line of demarkation was not ascertained. This silty clay outcrop or partial outcrop was also noticed along the trail which is near the river. Clay loam also appeared in the subsoil near well 6-123. The whole northern portion except in isolated areas appears to consist of loam and silt loam, with some peaty silt, underlaid by loam, in the extreme north.

Alkali Content by Bridge Tests.—Groups Nos. 33, 34, and 36 contained only a negligible amount of alkali. The groups in the south, Nos. 32, 33, 34, and 36, in which it was thought some alkali might be found, tested "negligible" although group 32 was found to contain a weak amount in the first one and one-half feet.

Tests of the groups 22, 23, and 35 indicated that a "weak" amount was present, probably 0·1 per cent to 0·2 per cent. As this quantity is almost negligible, and is confined to the upper two feet or less, there appears to be no probability that crops would ever suffer when they are present in the soil. The carbonates exist in average quantities throughout the district.

Alkali Content by Chemical Analysis.—Four samples were chosen for analysis, 32A, 32B, 22A, and 22B. Reference to Appendix 8 b will indicate that the amount of total salts, less Ca SO_4, is from 0·180 per cent downwards. Even the total amount is only 0·329 per cent or less. This soil is therefore innocuous.

Water Table.—The water table varied from 39·13 in well 6-224 to 45·38 in well 6-190 in the southern portion.

The wells in the south average about 44·5, or about 8·8 feet below the surface. Those in the remainder of the district average about 41·0, or 8·3 feet below the surface.

District 7

This is the most southerly district on the west side of the river and is shown on Maps 6 and 7, Appendix VI.

Soil.—Groups Nos. 29, 30, 31, 62, 63, and 64 were obtained at scattered points. The soil is of average consistency throughout the district. The first three feet consist mostly of sandy loam to silt loam except in the enclosed contour 54·0 near well 7-72 where some peat was found. The next four feet consist of loams to silty clay loam.

The first few inches of soil over most of the area, particularly in the south, is peaty and therefore spongy after cultivation. Carbonates are present in very small quantity.

Alkali Content by Bridge Tests.—Only one group, No. 29, which was obtained in the lowest area of the district, contained any trace of alkali. In this case it was apparently present in the first quarter-inch in moderately strong quantities and weak in the first five-tenths foot. It is to be remembered that this is the lowest point in the district, and that a "skim" sample, only, contained the alkali to any extent.

Alkali Content by Chemical Analysis.—Two samples, 29 A "Skim" and 29A, were analysed, the former to corroborate the bridge tests, and the latter to prove that hoar frost alkali does not extend to any appreciable depth. Both of these questions were favourably answered by results. It will be noted that half of the "Skim" sample consists of $Ca\ SO_4$ with only 0·092 per cent of $Na_2\ SO_4$.

Water Table.—The water table varies from 6·5 feet on the south to about 11·0 in the north. Near well 7-62, in the lowest area, it is only 3·6 feet from the surface, but this well is near a drainage ditch. These drainage ditches usually have standing water in the bottom. The northern portion has an average surface elevation of 60·0 or more, while that of the southern portion is about 52·0.

District 8

This is a large district on the east side of the river as shown on Map No. 1, Appendix VI, and being almost rectangular in shape and not divided by overflow channels, is the best and most convenient for cultivation. The general elevation only varies about two feet throughout the area, with the exception of a rise along the river at the north side.

Soil.—Groups Nos. 57, 58, 59, 60, and 61 were obtained in the district at widely scattered points; these are all typical of their respective areas. All samples indicated heavier soil than usual. Peat exists over most of the area to a depth of two feet or more. The soil below three feet consists principally of clay loam to silty clay loam. The whole area was sown to wheat which produced a good crop. Clay exists near the surface along the eastern portion.

Alkali Content by Bridge Tests.—In Group No. 58 alkali is apparently very negligible in amount to the depth of seven feet. The other groups indicate a weak amount to a depth of three feet but in only one case—Sample "A" of Group 60—is it very strong, and in that case for only one-half foot. The condition of the area as a whole is favourable. The total actual amount of alkali in the first three feet of the whole district, though larger than that of any other district, is still actually very small.

Alkali Content by Chemical Analysis.—Samples 59 A, C and D were analyzed. It was found that 59 A and 59 D contained very little total salts and a very small amount of $Na_2\ SO_4$, most of the salts consisting of $Ca\ SO_4$. Sample 59 C contained 0·918 per cent total salts but 0·782 per cent of this was $Ca\ SO_4$. These samples are therefore innocuous.

Water Table.—The water table varied from 7 to 9 feet, not differing greatly from the river.

District 9

This is one of the smallest districts and lies on the west side of the river as shown on Map No. 3, Appendix VI. It is very uneven, the surface lying in long ridges 3 or 4 feet high. A heavy yield of wheat was obtained. Groups Nos. 37, 38, 39, 40, 41 and 42 were obtained of which two double sets, Nos. 37 and 38, 39 and 40, were located at the crests and valleys respectively, of the ridges, each pair being located one hundred feet apart, or more. Group 41 was obtained in a low place near the lake in the midst of a wheat field. Apparently the lake covered this area when the map was made.

Soil.—The first three feet of soil is clayey in character with very little peat in evidence except near Kerr lake where the surface is low. The soil from 3 feet to 7 feet appears to possess more silt and sand and therefore is of a lighter character than the upper three feet. At first sight (the land was being ploughed) the soil appeared unfavourable because of the clay on the surface.

Alkali Content by Bridge Tests.—Groups No. 37, 38, 39, 40 and 42 appear to be comparatively free from alkali salts as they test "negligible" to a depth of seven feet. Group 41 tested "weak" to 1·5 feet, and then "negligible" to 7 feet. District 9 is therefore placed in an even more favourable position than the rest because of its comparative freedom from alkali. The upper two or three feet contain little or no carbonates, below three feet the percentage is much higher.

Alkali Content by Chemical Analysis.—Chemical analysis of these samples was not considered necessary, the bridge tests indicating favourable results.

Water Table.—The water table near the river stands about 43·0 to 44·0. In the centre of the district it is a little higher—45·0. It will be noted that the river almost surrounds this area, no portion being more than half a mile distant.

District 10

This average-sized district lies on the west side of the river, as shown on Maps 1 and 4, Appendix VI. It has only lately been reclaimed. The soil is apparently of two types—upland and slough. Two groups, Nos. 52 and 53, were obtained, one in each type.

Soil.—The slough land consists of clayey peat for the first three feet and silty clay loam from three to seven feet at least. Practically no carbonates are present in the soil column. The uplands consist of clay loam in the first three feet with a subsoil of silt loam from three to seven feet. Calcium carbonate is present in large quantities to the 7-foot depth.

Alkali Content by Bridge Tests.—According to the tests of Group No. 53 the slough area contains a "negligible" amount of alkali to seven feet depth. The uplands, as evidenced by results of testing Group 52, contain a "weak" amount to 1·5 feet and "negligible" to 7·0 feet. This condition apparently exists throughout the district. No suspicious signs of any kind were noted in vegetation or appearance of surface.

Alkali Content by Chemical Analysis.—No samples were chemically analysed from this District, the bridge results being favourable.

Water Table.—The water-table in this slough was at an elevation of about 49·0 while that of the uplands was 36·4. This result would seem to indicate that the slough soil is very dense, as it appears to hold the water. No drainage ditches have as yet been constructed to lower the water-table.

District 11

This large district is not as fully developed as some of the others. It consists largely of sloughs with only narrow strips of upland except in the extreme north and extreme south. It is shown on Maps No. 6 and 7, Appendix VI, and lies on the east side of the river.

Three representative groups were obtained in the area, No. 20 in the slough; one—group 56—in an area which is apparently clay; and one—65—at an apparently clay ridge along an overflow channel. Nos. 56 and 65 were obtained by request. The district is more than ordinarily divided by overflow channels with their attendant ridges and is partly occupied by Mission Hill, evidently springing from bed-rock and 200 feet high.

Soil.—The slough areas appear to consist of silty peat or peaty silt in the first three feet with silt loam from 3 to 7 feet. The wheat on former sloughs yielded a heavy crop.

The ridges along the overflow channels, on one of which group 65 was obtained, consist of silt loam in the first 3 feet and sandy silt in the next 4 feet. In other words, the soil on the ridges appears to be of lighter character than that of the lower lands. This, however, is in accordance with the theory before mentioned. Calcium carbonate is strong on the ridges and on the upland flat but only average in the sloughs.

Alkali Content by Bridge Tests.—The ridge sample, No. 65, tested " negligible " which is now to be expected; the slough sample, No. 20, tested " weak " and " negligible," and the upland group—56—tested negligible. These results are probably to be found over the district. The ridge group and upland group (56) were obtained at the request of the Agricultural Consultant for the company who was apprehensive of alkali salts in both types. However, none was found to any extent.

Alkali Content by Chemical Analysis.—Samples 20 A, C and D were chemically analysed. The first two samples contained only 0·229 per cent and 0·328 per cent respectively, of total salts; of which a very small amount consisted of Na_2SO_4.

Sample 20D contained 0·575 per cent total salts but 0·401 per cent was $CaSO_4$. All samples contained very little or no Na_2SO_4.

Water Table.—The water-table near the south end appears to vary from 43·0 to 48·0, while in the vicinity of 11-93A, which is nearer the north end, it is about 50·8.

District 12

This district lies on the west side of the river, as shown on Map No. 5, appendix VI. It contains a large area of upland with 300 or 400 acres of slough.

Soil Groups Nos. 50 and 51 were obtained and tested.

Soil.—The soil in the slough consists of peaty silt in the first three feet and clay loam from three feet to seven feet. The soil on the uplands consists of sandy loam to 3 feet and silt loam to at least 7 feet. The slough soils do not contain calcium carbonate but the uplands contain a large amount.

Alkali Content by Bridge Tests—Alkali is apparently present in "negligible" quantities only, all over the district, judging by the tests of the groups taken, viz: Nos. 50 and 51.

Alkali Content by Chemical Analysis—No samples from this district were chemically analysed.

Water Table—The water-table in the slough stands at about 48.0 while in the uplands its elevation is about 46.4.

United States Geological Survey Soil Samples

Thirty-one isolated soil samples were secured from Mr. Paulsen of the U.S.G.S. These samples were preserved when the wells were constructed. They were obtained from 11 different wells at depths varying from the surface to 32 feet. Complete logs were available from two wells—9-153 and 9-172, to depths of 32 and 29 feet respectively. The results of bridge tests will be found in Appendix 2, page 8.

Soils.—The soils varied from very fine sand to silty clay loam but the majority consisted of the lighter soils.

Alkali Content by Bridge Tests.—One sample—a surface sample from Well No. 6-219, tested moderately strong; two samples, Nos. 3 and 24, tested weak; two, Nos. 13 and 23, tested very weak; five, Nos. 6, 10, 27, 22 and 29, tested negligible, and twenty-one samples tested very negligible.

Alkali Content by Chemical Analysis.—No samples from this collection were chemically analysed.

Carbonates.—Three samples, No. 23, a sandy clay, No. 4, a peat and No. 6, a peaty silt, did not effervesce on application of dilute H Cl; one sample, No. 7, a silty clay loam, effervesced very feebly, while the remaining twenty-seven indicated a large amount of $CaCO_3$.

Free Water Samples

Six water samples were obtained at different points:—

1. A drain ditch near Well 4-147A. The water stood in pools at about the same elevation as the water-table.
2. Pump sump near Well 6-242. No water was draining through the outlet into the river.
3. A lake east of Well 8-261.
4. Kootenay river at international boundary.
5. Drain ditch at the main pumphouse near Well 1-50.
6. In slough on the south side of district 1 just before the drainage water enters the drain ditch. This sample was obtained from the north side of the drain at a point where seepage from the hills could not dilute it.

Alkali Content by Bridge Tests.—All samples, except No. 5 tested negligible. No. 5 tested very weak, or almost negligible.

The results of tests of water samples indicate that the water of the Kootenay river does not hold any appreciable salts in solution. The only appreciable amount is contained in No. 5 which was obtained near the outlet of the drainage ditch of District 1. A small amount of alkali was found near Wells 1-8 and 1-12. The ditch collects all drainage water from District 1 and thus the result of tests is logical but the amount is too small to be injurious in any way.

The results of bridge testing are shown on Appendix II, page 8.

Alkali Content by Chemical Analysis.—Water samples Nos. 1, 2, 4, 5 and 6 were chemically analysed. As alkali salts are of necessity soluble in water, it is logical to state that they must appear in drainage waters originating in the valley, if present to any large extent in the soils. For this reason five of the six samples, obtained by careful selection, were analysed.

Reference to Appendix 8b will indicate the paucity of salts in all five examples. The salt content varied from 0·070 per cent to 0·011 per cent total salts and from 0·069 per cent to 0·008 per cent of total salts less $CaSO_4$. Very little Na_2SO_4 was found to be present.

The degree of concentration represented by these amounts may be understood by comparing them with the alkali salts contained in the Bow and Elbow rivers at Calgary. These rivers are considered to be practically pure. The Bow river contains 0·025 per cent, and the Elbow river 0·021 per cent of total salts. It will be noted that these amounts are very similar to those of the waters in Kootenay valley. Columns J and K of Appendix 8b agree remarkably well, graphically.

IV. Conclusions

The conclusions which follow are deduced from the results of III, 1, 2 and 3, by the writer, who is more or less familiar with alkali salts and their effect on vegetation. They are as follows:—

(*a*) The origin of the alluvial deposits in Kootenay valley would appear to indicate at the outset that sodium and magnesium salts should not be found in any great quantity in the valley. The higher masses consist of quartzites, argillites and dolomites. These contain very little harmful alkali salts.

(*b*) Alkali is not present in the soils of either the Canadian or United States Kootenay valley in sufficient quantities, in the areas under consideration, to a depth of at least seven feet, to be harmful to the growth of crops. This conclusion was reached after a study of nearly four hundred samples. A criticism might be made that an insufficient number of samples were obtained for a general conclusion. The sixty-five locations, however, were carefully chosen from the areas nearest suspicion. The results of examining the whole area in detail, acre by acre, would probably make very little change. Any procedure even approximating the latter would obviously be impossible.

(*c*) Even if the entire alkali content present within five feet of the surface were concentrated within the average root zone, no plant life could be injured by its presence. The evidence offered by soil tests from the deep wells on the United States side—some of them extending to a depth of thirty-two feet—indicates that no alkali in harmful quantities is present in the soils from seven feet to thirty-two feet at least. These conclusions are equally true on the Canadian side, as very little difference was noted between the soils on either side of the boundary. They are further substantiated by the results of chemical analyses and their known relations with bridge tests.

(*d*) Should there have been alkali indigenous to the soil, most of it was leached out long ago by the movement of soil waters and carried away by country drainage.

(*e*) The "hoar-frost" effect, whatever may have been its origin, is so small in amount that it cannot under any circumstances prove injurious to the growth of plants. No authoritative explanation has been advanced for this condition. It may be due to the concentration of the minute amount of alkali present in the first foot or two of the soil under especially favourable conditions for its appearance, as it usually occurs in small areas of a hundred feet or so in diameter, and then very infrequently, and is only present on the surface in a barely perceptible layer. The soil immediately beneath the first eighth, or quarter-inch, used as the first sample in the group, is usually practically free from alkali. The skim samples, such as 27A and 29A, presage no danger of a rise of alkali or injury to crops. They are also found to consist largely of $CaSO_4$ and need not be seriously considered. No injurious or other effects on plant growth by the presence of alkali were noted in any portion of the valley.

(*g*) There can be no doubt but that the raising of the water-table in the winter will not have any effect on any possible content of alkali. A further proof of this statement is the present surface condition of the soil.

(*h*) No alkali is present in any of the water samples to the least injurious extent. The largest amount found in any water sample was 0·07 per cent by weight. Evidently very little alkali is left in the valley, if it were ever present in large amounts, to be carried by the river.

(*i*) A numerical analysis of bridge results of testing for alkali-content on both the Canadian and United States sides of the boundary, for each separate depth, as given in Appendix 5, indicates in graphical form the paucity of alkali present in the soils.

(*j*) The results of chemical analysis corroborate the bridge results but in a more exact and authoritative manner. The actual harmful salt content is now known. This was an unknown quantity before the chemical analyses were completed. These indicate that the bridge results comprise a fair indication of the amount of injurious salts present in soils.

(*k*) It would seem from a study of bridge and chemical data that the present conditions would indicate no detrimental effects from the alkali salts (with the possible exception of "No. 27A skim" and ("29A skim") which are dealt with above in (*e*).

(*l*) It is just possible that the toxic condition of the peat samples are less serious even than is indicated by the bridge tests or chemical analysis.

(*m*) The greater portion of the salts consists of calcium sulphate with very small quantities of sodium sulphate as a rule. Calcium sulphate, although it has nearly the same resistance as sodium sulphate, is only 2 per cent soluble in water, while sodium and magnesium sulphates are about 40 per cent soluble. Calcium sulphate is not nearly so toxic as sodium sulphate. The bridge tests indicate less salts than are actually present, although this statement does not affect the general conclusions, the actual salt-content being still small.

(*n*) The alkali carbonates are present in the soil solution in the form of bi-carbonate, and are very small in amount.

(*o*) The favourable appearance of crops in all parts of the valley would appear to corroborate the bridge tests and chemical analysis.

(*p*) Seepage water was noted at many points on both sides of the valley, near the toe of the slopes. This water, whether originating under a false bedrock as mentioned under District 1, "seepage," in the hills or, remotely, from the creeks, undoubtedly has the effect of raising the water table. Certain evidence partially supports the false bedrock theory of origin of the seepage water around the edge of the flat. The amount of water delivered by this seepage is impossible to compute but the aggregate must be very large throughout the valley.

(*q*) No didactic statements can be made in this report regarding the relations between the elevations of water-table and river. A study of well data over a period of time is necessary before this can be done. An inspection of the river banks when the water is low would assist to this end. Statements regarding "lag" of water-table in this report are tentative, as that question is mostly outside its province, isolated wells and group locations only having been inspected. However, during the period of inspection several wells were known to indicate a drop in water-table level.

(*r*) The safe minimum depth of water-table for the growth of plants lies between four and six feet during the latter part of the growing season, the former being considered as effective and the latter safe.

Appendices will be found attached to this report as follows:—

1. Sixty-five soil-investigation sheets and six water-investigation sheets.
2. Eight sheets containing condensed data from soil sheets and level notes.
3. Canadian profiles from groups to river.

4. Map containing locations and condensed soil data of the Canadian samples.

5. Numerical analysis of alkali content of Canadian and United States samples.

6. Nine topographical maps—Sheets Nos. 1 to 9 inclusive—of the United States side containing location and data appertaining to each group.

7. A copy of classification of soil materials as used by the United States Bureau of Soils.

8. Results of Chemical Analysis.
   - 8a. Original Chemist's Analysis Reports. Sixteen sheets altogether.
   - 8b. Percentage of Salts by Atomic Theory.
   - 8c. Salt Content of Soils in Graphical form.

Photographs.—No photographs were obtained during the inspection. Detail pictures could only indicate wheat stubble or burned, ploughed and levelled surfaces with no distinguishing points. Many general photographs of the valley must be available.

Six copies of the complete report have been prepared.

(Sgd.) J. S. TEMPEST,
Commissioner of Irrigation.

(Sgd.) P. A. FETTERLY,
Assistant Hydraulic Engineer.

NOTE

The following appendices to the Fetterly report are not reproduced herein but are on file in the offices of the Commission in Ottawa and Washington.

Appendix 1, sixty-five soil-investigation sheets and six water-investigation sheets. The information in condensed form is contained in Appendix 2.

Appendix 3, Kootenay Flats, B.C., Profiles from river to group locations.

Appendix 4, Map of Kootenay Flats showing location of Canadian samples.

Appendix 6, Nine topographical maps, United States side, containing location and data appertaining to each group of samples.

Appendix 8c, Salt Content and Resistance, Soils from Kootenay Flats (in graphical form).

APPENDIX 2

KOOTENAY FLATS

British Columbia Soil Samples, 1930,

To Accompany Report of P. A. Fetterly dated February 20, 1932

Group No.	Location	Sample	Depth	Resistance in Ohms	Alkalinity	Color (wet)	Material	Moisture	General Type 0-3′	General Type 3-7′	Amount of $CaCO_3$ by HCl test	W.L. of Kootenay river	Top of dyke or bank	Ground L. at group	W.L. at group	Samples for analysis
1	SE. 3, tp. 7	A skim	0″·25	197	W	Dark brown	Sandy loam	D	Sandy		Strong	1,743·07	1,761·49	1,750·59	1,744·99	Yes
		A	0′·5	308	W	Dark grey	Lt. sandy loam	M	Loam							
		B	1′·5	462	N	Ltr. br. grey	Lt. sandy loam	M								
		C	3′·0	648	N	Ltr. br. grey	Silty sand	M								
		D	5′·0	555	N	Br. slate grey	Silty sand	D		Loam						
		E	7′·0	514	N	Dk. slate grey	Sandy silt	W								
2	NW. 11, tp. 7	A skim	0″·25	179	M.S.	Grey	Fine sandy loam	M	Sandy		Strong	43·07	67·23	46·73	43·93	Yes
		A	0′·5	395	W	Grey	Fine sandy loam	D	Loam							
		B	1′·5	565	N	Yellow grey	Sandy loam	W								
		C	3′·0	936	N	Slate	Loam	W		Silt						
		D	5′·0	912	N	Slate	Loam	W		Loam						
		E	7′·0	924	N	Slate	Silt loam	W								
3	NE. 14, tp. 7	A	0′·5	791	N	Pale brown	Clayey peat	M	Clayey		Strong	43·07	63·40	53·07	48·17	No
		B	1′·5	1,266	N	Pale brown	Clayey peat	M+	Peat							
		C	3′·0	912	N	Slate	Silty clay	D								
		D	5′·0	719	N	Slate	Silty clay	D+		Silty						
		E	7′·0	658	N	Slate	Silty clay	W		Clay						
4	SW. 29, tp. 8	A	0′·5	1,388	N	Brown grey	Peaty silt	M−	Silt		Strong	43·07	61·31	51·29	Below 44·29	Yes
		B	1′·5	1,922	N	Brown grey	Clayey silt	M−	Loam							
		C	3′·0	1,250	N	Yel. br. grey	Clayey silt	M								
		D	5′·0	1,434	N	Yel. br. grey	Sandy clay	D		Sandy						
		E	7′·0	1,458	N	Yel. br. grey	Sandy clay	D+		Clay						
5	NW. 7, tp. 11	A	0′·5	1,196	N	Lt. yel. grey	Silt loam	M	Silt		Strong	Duck L. 43·07	....	45·67	41·17	No
		B	1′·5	1,356	N	Dk. yel. grey	Silt loam	M	Loam							
		C	3′·0	1,317	N	Dkr. yel. grey	Clay loam	M+								
		D	5′·0	1,196	N	Yellow slate grey	Clay loam	D		Clay						
		E	7′·0	1,328	N	Yellow slate grey	Clay loam	W		Loam						
6	NW. 7, tp. 11	A	0′·5	1,700	N	Yellow slate grey	Light clay silt	M−	Silt		Strong	Duck L. 43·07	....	49·42	42·52	Yes
		B	1′·5	2,134	N	Light yel. slate grey	Light clay silt	M	Loam							
		C	3′·0	1,656	N	Yellow slate grey	Light clay silt	D−								
		D	5′·0	1,432	N	Yellow slate grey	Light clay silt	D		Clay						
		E	7′·0	1,266	N	Ochre slate grey	Light clay silt	W		Loam						
7	NW. 6, tp. 11	A	0′·5	974	N	Yellow slate grey	Silt loam	M	Silt		Strong	43·00 Slough nr. sample also 43·00	61·08	44·66	42·86	Yes
		B	1′·5	994	N	Light yel. slate grey	Silt loam	D	Loam							
		C	3′·0	1,076	N	Light yel. slate grey	Silt loam	W								
		D	5′·0	961	N	Light yel. slate grey	Silt loam	W		Silt						
		E	7′·0	1,052	N	Light yel. slate grey	Silt loam	W		Loam						

APPENDIX 2—*Continued*

KOOTENAY FLATS

British Columbia Soil Samples, 1930

To Accompany Report of P. A. Fetterly dated February 20, 1932

Group No.	Location	Sample	Depth	Resistance in Ohms	Alkalinity	Color (wet)	Material	Moisture	General Type 0-3′	General Type 3-7′	Amount of $CaCO_3$ by HCl. test	W.L. of Kootenay river	Top of dyke or bank	Ground L. at group	W.L. at group	Samples for analysis
24	NE. 8, tp. 8....	A......	0′·5	843	N	Brown grey.........	Peaty clay loam....	M–	Fine......	....	Weak.....	42·57	61·74	52·32	Below 45·17	Yes
		B......	1′·5	1,212	N	Dark khaki grey...	Fine sandy loam....	M–	sandy....	....	None.....	....				
		C......	3′·0	1,489	N	Light khaki grey...	Silt loam...........	M	loam.....	....	Strong....					
		D......	5′·0	1,797	N	Lighter khaki grey.	Fine sandy loam....	M+	....	Fine......	Strong....					
		E......	7′·0	1,797	N	Lighter khaki grey.	Fine sandy loam....	D		sandy loam	Strong....					
25	SE. 27, tp. 7....	A......	0′·5	949	N	Brown grey.........	Silt, loam and humus	M–	Silt......	....	Strong....	42·57	62·35	53·24	46·24	Yes
		B......	1′·5	1,196	N	Dark khaki grey...	Silt loam...........	M–	Loam....	....	Strong....					
		C......	3′·0	1,248	N	Dark khaki grey...	Silt loam...........	M	....	....	Weak.....					
		D......	5′·0	1,286	N	Yellow grey........	Silt loam...........	M+	....	Silt......	Strong....					
		E......	7′·0	1,279	N	Yellow grey........	Silt loam...........	DtoD+	....	Loam....	Strong....					

Idaho Soil Samples, 1930

Group No.	Location	Sample	Depth	Resistance in Ohms	Alkalinity	Color (wet)	Material	Moisture	General Type 0-3′	General Type 3-7′	Amount of $CaCO_3$ by HCl. test	Top of pipe	Ground L. at group	W.L. in well	W.L. at group	Samples for analysis
12	300′S. of 1-8....	A......	0′·5	254	W	Brown grey.........	Silt loam...........	M–	Silt......	....	Weak.....	1,748·04	1,747·35	1,740·84	1,741·80	No
		B......	1′·5	259	W	Lighter brown grey.	Silt loam...........	M–	Loam....	....	Weak.....					
		C......	3′·0	264	W	Dark brown grey...	Heavy silt loam....	M+	....	....	None.....					
		D......	5′·0	360	W	Dark brown grey...	Heavy silt loam....	D	....	Clay.....	Strong....					
		E......	7·0′	925	N	Dark brown grey...	Light clay loam....	D+toW	....	Loam....	Strong....					
26	560′S. of 1-8....	A......	0′·5	221	W	Dark khaki grey...	Light clay loam....	M–	Silt......	....	Weak.....	48·04	47·18	40·69	42·38	Yes
		B......	1′·5	239	W	Dark khaki grey...	Light clay loam....	M	Loam....	....	Weak.....					
		C......	3′·0	242	W	Dark khaki grey...	Light clay loam....	D–	....	....	None.....					
		D......	5′·0	590	N	Slate...............	Silt loam...........	W	....	....	Strong....					
		E......	7′·0	817	N	Slate...............	Clay loam..........	W	....	Clay.....	Strong....					
		F......	10′·0	703	N	Slate...............	Clay loam..........	W	....	Loam....	Strong....					
		G......	15′·0	1,001	N	Slate...............	Clay loam..........	W	....	....	Strong....					
		H......	20′·0	697	N	Slate...............	Clay loam..........	W	....	....	Strong....					

11	190'E. & 12'N. of 1-11	A	0'·5	668	N	Yellow brown grey	Silt loam	M–	Silt loam		Not found	51·52	52·50	40·32	Below 45·50	No
		B	1'·5	1,165	N	Yellow brown grey	Silt loam	M–								
		C	3'·0	800	N	Yellow brown grey	Fine sandy loam	M		Fine sandy loam						
		D	5'·0	700	N	Yellow slate grey	Fine sandy loam	M								
		E	7'·0	950	N	Yellow slate grey	Fine sandy loam	M+								
10	1120'E. & 130'S. of 1-12	A skim	0"·25	72	V.S.	Yellow brown grey	Silt loam	M–	Fine sandy loam		Not found	50·74	50·87	46·51	Below 43·87	No
		A	0'·5	572	N	Yellow brown grey	Fine sandy loam	M–								
		B	1'·5	1,120	N	Yellow brown grey	Fine sandy loam	M–								
		C	3'·0	884	N	Yellow brown grey	Fine sandy loam	M								
		D	5'·0	534	N	Light brown grey	Fine sandy loam	M+		Coarse sand						
		E	7'·0	580	N	Slate grey	Fine to coarse sand	M								
8	275'W. & 95'S. of 1-12	A	0'·5	500	N	Brown grey	Fine sandy loam	M–	Sandy loam		Not found	50·74	49·50	46·51 E. hole 10'E. of 1-12- 38·44	Below 42·50	Yes
		B	1'·5	541	N	Brown grey	Sandy loam	M–								
		C	3'·0	582	N	Brown grey	Sandy loam	M								
		D	5'·0	603	N	Yellow brown grey	Silt loam	M+		Silt loam						
		E	7'·0	640	N	Yellow brown grey	Silt loam	M+								
16	675'W. & 1,620'N of 1-12	A	0'·5	548	N	Brown slate	Silt, loam & humus	M–	Silt loam		None	50·74	50·70	46·56	Below 43·70	No
		B	1'·5	596	N	Light brown slate	Silt, loam & humus	M			None					
		C	3'·0	567	N	Yellow grey	Silt loam	M+			Weak					
		D	5'·0	836	N	Yellow grey	Silt loam	D		Silt loam	Strong					
		E	7'·0	796	N	Dark yellow grey	Silt loam	D			Strong					
27	1,125'E. & 100'S. of 1-12	A skim	0"·25	92	S	Dark khaki grey	Fine sandy loam	M	Fine sandy loam		Strong	50·74	51·24	46·14	Below 44·24	Yes
		A	0'·5	632	N	Dark khaki grey	Fine sandy loam	M			Strong					
		B	1'·5	1,269	N	Yellow grey	Loam	M+			Strong					
		C	3'·0	1,540	N	Lighter yellow grey	Silt loam	M+		Clay loam	Strong					
		D	5'·0	962	N	Lighter yellow grey	Silt loam	D			Strong					
		E	7'·0	858	N	Blue grey	Silty clay loam	D								
13	355'S. & 50'W. of 1-13	A	0'·5	925	N	Dark brown grey	Silt loam	M–	Silt loam		Not taken	51·03	49·21	42·68	Below 42·21	No
		B	1'·5	706	N	Lighter brown grey	Silt loam	M–								
		C	3'·0	597	N	Yellow slate grey	Silt loam	M								
		D	5'·0	687	N	Light brown grey	Fine sandy loam	M+		Clay loam						
		E	7'·0	687	N	Blue grey	Light clay loam	D–								
15	1,385'S. & 600'W. of 1-19	A	0'·5	1,386	N	Khaki grey	Silt loam	M–	Silt loam		Not taken	59·59	60·44	43·41	53·64 (below)	No
		B	1'·5	1,540	N	Dark khaki grey	Light silt loam	M–								
		C	3'·0	2,465	N	Dark khaki grey	Light silt loam	M–								
		D	5'·0	2,465	N	Dark khaki grey	Fine loam	M		Loam						
		E	7'·0	2,567	N	Dark khaki grey	Fine loam	M+								
14	570'S. & 310'W. of 1-30	A	0'·5	344	W	Brown grey	Light silt loam & humus	M–	Loam		Not taken	59·11	54·49	46·96	Below 47·49	No
		B	1'·5	493	N	Yellow slate	Silt, loam & humus	M								
		C	3'·0	462	N	Light yellow slate	Silt loam	M+								
		D	5'·0	770	N	Red slate	Silt loam	M+		Silt loam						
		E	7'·0	719	N	Light slate	Silt loam	D								
17	830'N. & 180'W. of 1-30	A	0'·5	843	N	Khaki grey	Light silt loam	M–	Silt loam		None	59·11	63·01	46·96	Below 56·01	No
		B	1'·5	678	N	Light khaki grey	Light silt loam	M–			Strong					
		C	3'·0	899	N	Light khaki grey	Fine sandy loam	M–			Strong					
		D	5'·0	1,489	N	Light khaki grey	Fine sandy loam to fine sand	M		Sand	Strong					
		E	7'·0	2,157	N	Light khaki grey	Coarse sandy loam and coarse sand	M			Strong					

APPENDIX 2—*Continued*

Idaho Soil Samples, 1930

Group No.	Location	Sample	Depth	Resistance in Ohms	Alkalinity	Color (wet)	Material	Moisture	General Type 0-3′	General Type 3-7′	Amount of $CaCO_3$ by HCl. test	Top of pipe	Ground L. at group	W.L. in well	W.L. at group	Samples for analysis
28	947′W. & 423′S. of 1-32	A skim.	0″·25	174	M.S.	Yellow slate	Sandy loam	M–	Sandy		Strong	55·21	51·04	47·61	47·34	No
		A	0′·5	285	W	Dark yellow slate	Sandy loam	M	loam		Strong					
		B	1′·5	790	N	Yellow slate	Silt loam	M+			Strong					
		C	3′·0	707	N	Brown slate	Clay loam	D–		Silty	Avge					
		D	5′·0	499	N	Brown slate	Clay loam	D+		clay	Avge					
		E	7′·0	624	N	Blue slate	Clay	W		loam	Strong					
18	343′W. & 20′N. of 1-43	A	0′·5	358	W	Brown slate	Silt, loam & humus.	M–	Silt		Weak	51·65	49·10	40·56 (last reading on post)	36·90	No
		B	1′·5	401	N	Brown slate	Silt, loam & humus.	M–	loam		Weak					
		C	3′·0	483	N	Brown slate	Silt, loam & humus.	M			None					
		D	5′·0	472	N	Brown slate	Silt loam	M+			Strong					
		E	7′·0	719	N	Khaki slate	Silt loam	M+		Silt loam.	Strong					
		F	10′·0	706	N	Khaki slate	Loam	D			Strong					
		G	15′·0	738	N	Brown slate	Clay loam	W		Clay loam	None					
		H	20′·0	1,078	N	Lighter brown slate.	Clay loam	W		to 20′	Strong					
19	1-Recording well No. 1	A	0′·5	1,159	N	Brown grey	Silt loam	M	Silt loam.		None					No
		B	Next few ft.. bottom	452	N	Yellow brown grey.	Sandy loam	D		Sandy	Strong					
		C		1,592	N	Yellow brown grey.	Sandy loam	W		loam	Strong					
48	127′W. & 30′N. 3-104-A	A	0′·5	208	W	Brown	Peat	M+	Silty		None	55·30	53·55	51·40	50·95	No
		B	1′·5	314	W	Yellow brown	Silty peat	D	peat		None					
		C	3′·0	500	N	Yellow slate	Clayey peat	D+			None					
		D	5′·0	873	N	Slate	Clayey peat	D+toW		Silty clay	None					
		E	7′·0	800	N	Light slate	Silty clay loam	W		loam	None					
49	135′W. & 127′N. of 3-105	A	0′·5	232	W	Brown	Peat	M+	Peat		None	61·74	55·34	45·54	49·00	No
		B	1′·5	349	W	Brown	Peat	M+			None					
		C	3′·0	318	W	Brown	Silty peat	D			None					
		D	5′·0	842	N	Light slate	Clay loam	D+toW		Clay	None					
		E	7′·0	1,356	N	Light slate	Clay loam	W		loam	None					
46	115′E. & 270′N. of 4-131	A	0′·5	510	N	Yellow slate	Sandy loam	M–			Strong	65·58	54·05	42·88	Below 47·05	No
		B	1′·5	659	N	Slate	Loam	M–	Loam		Weak					
		C	3′·0	822	N	Khaki slate	Silt loam	M			Strong					
		D	5′·0	781	N	Khaki slate	Silt loam	M+		Silt	Strong					
		E	7′·0	822	N	Light khaki slate	Silt loam	M+		loam	Strong					
45	130′W. & 20′S. of 4-139	A	0′·5	548	N	Dark brown	Silty peat	M–	Silty		Weak	57·64	54·74	46·34	Below 47·74	No
		B	1′·5	380	W	Dark brown	Silty peat	M	peat		None					
		C	3′·0	616	N	Yellow slate	Peaty silt	M+			None					
		D	5′·0	499	N	Dark brown	Peaty silt	D–		Peaty	None					
		E	7′·0	425	N	Dark brown	Peaty silt	D		silt	None					

21	480′W. of 4-143A	A	0′·5	495	N	Dark brown slate	Peat	M–	Peat		Not taken	57·05	54·17	49·00	About 47·20	Yes
		B	1′·5	370	W	Dark brown slate	Peat	M								
		C	3′·0	370	W	Brown slate	Peat	M+								
		D	5′·0	272	W	Brown slate	Peat	D		Peaty silt						
		E	7′·0	452	N	Light brown slate	Peaty silt	D+								
44	110′W. & 20′S. of 4-146	A	0′·5	960	N	Dark brown	Peat	M–	Silty peat		None	55·17	55·87	44·07	Below 48·87	No
		B	1′·5	843	N	Dark brown	Silty peat	M–			None					
		C	3′·0	637	N	Light brown grey	Peaty silt	M			None					
		D	5′·0	697	N	Slate	Clay loam	M+		Clay loam	None					
		E	7′·0	1,130	N	Light khaki slate	Clay loam	M+			Strong					
47	340′S. & 130′E. of 4-147A	A skim.	0″·25	179	M.S.	Brown	Peat	D	Peat		None	55·50	55·02	51·80	52·02 (In ditch = 52·52)	Yes, in paper bags.
		A	0′·5	267	W	Brown	Peat	M+			None					
		B	1′·5	534	N	Brown	Peat	D			None					
		C	3′·0	406	N	Brown	Peat	D			None					
		D	5′·0	588	N	Brown grey	Peaty clay loam	W		Silty clay loam	None					
		E	7′·0	810	N	Light khaki slate	Silty clay loam	W			Strong					
9	340′S. & 130′E. of 4-147A	A skim.	0″·25	104	S	Brown	Peat	D+	Peat		Not taken	....	....	....	....	No
43	180′W. & 40′N. of 4-158	A	0′·5	880	N	Brown	Peat	M–	Peat		None	55·13	54·83	47·93	Below 47·83	Yes
		B	1′·5	582	N	Brown	Peat	M–			None					
		C	3′·0	593	N	Light brown	Silty peat	M			None					
		D	5′·0	489	N	Light brown	Silty peat	M+toD		Clay loam	None					
		E	7′·5	575	N	Blue grey	Silty clay loam	D+			None					
55	330′W. of 5-112	A	0′·5	229	W	Brown slate	Peaty loam	M+	Peaty loam		Weak	58·33	56·53	49·43	Below 49·53	No
		B	1′·5	341	W	Dark khaki slate	Peaty loam	M			Strong					
		C	3′·0	291	W	Brown slate	Peaty loam	M+			None					
		D	5′·0	250	W	Dark khaki slate	Peaty clay loam	D		Clay loam	None					
		E	7′·0	308	W	Blue slate	Silty clay loam	D+			Weak					
54	205′W. & 20′S. of 5-118	A	0′·5	348	W	Brown slate	Clayey peat	M	Clayey peat		None	57·17	56·37	50·28	About 51·00	Yes
		B	1′·5	333	W	Brown slate	Clayey peat	M			None					
		C	3′·0	244	W	Brown slate	Clayey peat	M+			None					
		D	5′·0	192	W	Light brown slate	Peaty clay loam	D		Clay loam	None					
		E	7′·0	224	W	Light brown slate	Clay loam	D+			None					
33	370′S. of 6-179B	A	0′·5	469	N	Brown slate	Sandy loam	M–	Fine sandy loam		Strong	55·95	54·38	44·35	Below 47·38	No
		B	1′·5	527	N	Yellow brown slate	Fine sandy loam	M–			Strong					
		C	3′·0	464	N	Dark yellow slate	Fine sandy loam	M			Weak					
		D	5′·0	520	N	Slate	Sandy clay	M+		Clay loam	None					
		E	7′·0	832	N	Khaki slate	Silty clay loam	M+			Strong					
36	530′E. of 6-183	A	0′·5	686	N	Brown grey	Loam	M–	Silt loam		Weak	55·67	52·90	43·67	Below 45·90	No
		B	1′·5	1,175	N	Khaki grey	Silt loam	M			Strong					
		C	3′·0	1,540	N	Light khaki grey	Silt loam	M+			Strong					
		D	5′·0	1,438	N	Light khaki grey	Silt loam	D–		Silt loam	Weak					
		E	7′·0	1,540	N	Light khaki grey	Silt loam	D+			Weak					
32	138′W. & 5′S. of 6-190	A	0′·5	295	W	Slate	Silt loam	M–	Silt loam		Strong	54·18	54·21	45·38	Below 47·21	Yes
		B	1′·5	374	W	Khaki grey	Silt loam	M–			Strong					
		C	3′·0	400	N	Dark khaki grey	Clay loam	M			Strong					
		D	5′·0	431	N	Dark khaki grey	Silty clay loam	D		Silty clay loam	Avge.					
		E	7′·0	458	N	Light khaki grey	Silty clay loam	D+			Strong					

APPENDIX 2—*Continued*

Idaho Soil Samples, 1930

Group No.	Location	Sample	Depth	Resistance in Ohms	Alkalinity	Color (wet)	Material	Moisture	General Type		Amount of $CaCO_3$ by HCl. test	Top of pipe	Ground L. at group	W.L. in well	W.L. at group	Samples for analysis
									0-3′	3-7′						
34	535′W. of 6-202	A	0′·5	427	N	Brown slate	Clay loam	M−	Clay loam		None	57·35	52·36	41·35	Below	No
		B	1′·5	686	N	Brown slate	Clay loam	M			None				45·36	
		C	3′·0	1,040	N	Yellow slate	Silty clay loam	M+		Silty	None					
		D	5′·0	1,300	N	Yellow slate	Silty clay loam	M+		clay	Strong					
		E	7′·0	1,356	N	Light yellow slate	Silty clay loam	D−		loam	Strong					
22	322′W. of 6-213	A	0′·5	232	W	Yellow slate	Silt, loam & humus	M−	Silt loam		Weak	50·22	49·24	42·32	Below	Yes
		B	1′·5	272	W	Yellow slate	Silt, loam & humus	M−			Average				42·24	
		C	3′·0	370	W	Yellow slate	Silt loam	M			Weak					
		D	5′·0	575	N	Light yellow slate	Loam	M+		Clay	Average					
		E	7′·0	431	N	Blue slate	Clay loam	M+		loam	Average					
35	170′W. & 70′S. 6-224	A	0′·5	324	W	Khaki grey	Fine sandy loam	P	Fine		Strong	51·53	51·25	39·13	Below	No
		B	1′·5	827	N	Khaki grey	Fine sandy loam	M−	sandy		Strong				44·25	
		C	3′·0	1,224	N	Khaki grey	Fine sandy loam	M	loam		Strong					
		D	5′·0	700	N	Light khaki grey	Silt loam	M		Silt	Strong					
		E	7′·0	700	N	Light khaki grey	Silt loam	M+toD		loam	Strong					
23	320′W. of 6-255	A	0′·5	464	N	Brown grey	Peaty silt	P	Peaty		Not taken	53·09	49·98	41·19	Below	Yes
		B	1′·5	349	W	Brown grey	Peaty silt	M−	silt					(last	42·98	
		C	3′·0	401	N	Khaki grey	Silt loam	M−						reading		
		D	5′·0	514	N	Light khaki grey	Loam	M		Loam				on post)		
		E	7′·0	565	N	Light khaki grey	Loam	M+								
64	170′S. of 7-47	A	0′·5	653	N	Yellow slate	Sandy clay	M−	Sandy		None	55·83	53·18	46·93	Below	No
		B	1′·5	884	N	Dark khaki slate	Sandy clay	M	clay		None				46·18	
		C	3′·0	1,976	N	Light khaki slate	Clayey sand	M			None					
		D	5′·0	1,040	N	Dark khaki slate	Clayey sand	M+toD	-	Loam	None					
		E	7′·0	1,175	N	Blue slate	Sandy clay	D								
29	553′N. & 335′W. of 7-62	A skim.	0″·25	132	M.S.	Khaki grey	Silt loam	M−	Silt		None	51·78	49·86	46·28	46·16	Yes
		A	0′·5	390	W	Khaki grey	Silt loam	M−	loam		None					
		B	1′·5	1,196	N	Khaki grey	Loam	M			None					
		C	3′·0	2,184	N	Dark khaki grey	Sandy clay	M+toD		Silty	None					
		D	5′·0	1,223	N	Blue	Sandy clay	D+		clay	None					
		E	7′·0	1,040	N	Blue	Clay	W		loam	Weak					
30	805′N. & 20′E. of 7-72	A	0′·5	698	N	Brown grey	Peaty silt	M−	Silty peat		None	53·65	52·37	45·75	Below	Yes
		B	1′·5	822	N	Light brown grey	Silty peat	M			None				45·37	
		C	3′·0	899	N	Yellow slate	Clay loam	M		Silty clay	Weak					
		D	5′·0	760	N	Yellow slate	Silty clay loam	M		loam	None					
		E	7′·0	796	N	Blue	Clay	M			None					

31	302′N. & 435′W. of 7-77	A	0′·5	1,196	N	Brown grey	Silt, loam & humus	M−	Silt loam		None	65·55	59·03	48·05	Below 52·03	Yes
		B	1′·5	1,592	N	Dark khaki grey	Silt loam	M−			None					
		C	3′·0	1,181	N	Light khaki grey	Silt loam	M			None					
		D	5′·0	2,157	N	Yellow grey	Silt loam	M+		Silt loam	Strong					
		E	7′·0	2,178	N	Yellow grey	Silt loam	DtoD+			Strong					
62	40′N. & 20′W. of 7-78	A	0′·5	915	N	Slate	Clay loam	M−	Clay loam		None	59·36	60·51	47·86	Below 53·51	No
		B	1′·5	1,144	N	Dark khaki slate	Clay loam	M−			None					
		C	3′·0	1,352	N	Khaki	Silt loam	M−			None					
		D	5′·0	1,768	N	Light khaki	Silt loam	M		Silt loam	Strong					
		E	7′·0	2,184	N	Light khaki	Sandy silt	M			Strong					
63	40′N. & 10′E. of 7-78	A	0′·5	759	N	Yellow slate	Sandy loam	M	Sandy loam		None	59·36	56·61	47·86	Below 49·61	No
		B	1′·5	863	N	Dark khaki slate	Sandy loam	M			None					
		C	3′·0	1,165	N	Light khaki slate	Sandy loam	M			None					
		D	5′·0	1,165	N	Light khaki slate	Clayey sand	M+		Sandy clay	None					
		E	7′·0	1,685	N	Light khaki slate	Sandy clay	D−			None					
60	330′W. of 8-258	A	0′·5	37	U.S.	Dark brown	Peat	M	Peat		None	52·92	50·57	45·12	45·39	No
		B	1′·5	298	W	Dark brown	Peat	M+			None					
		C	3′·0	246	W	Dark brown	Silty peat	M+			None					
		D	5′·0	380	W	Dark yellow slate	Clay loam	D		Clay loam	None					
		E	7′·0	912	N	Light yellow slate	Clay loam	D			Strong					
61	370′E. of 8-260	A	0′·5	385	W	Brown slate	Clayey peat	M−	Clayey peat		None	55·32	51·82	42·82	Below 44·82	No
		B	1′·5	224	W	Brown slate	Clayey peat	M			None					
		C	3′·0	218	W	Brown slate	Clayey peat	M			None					
		D	5′·0	307	W	Grey slate	Clay loam	M+		Clay loam	Weak					
		E	7′·0	780	N	Yellow grey slate	Clay loam	D−			Strong					
59	105′S. & 10′E. of 8-268	A	0′·5	350	W	Light brown slate	Silty peat	M−	Peat		None	54·18	51·01	45·28	45·01	Yes
		B	1′·5	324	W	Dark brown slate	Peat	M			None					
		C	3′·0	246	W	Dark brown slate	Peat	M			None					
		D	5′·0	420	N	Khaki slate	Silty clay loam	M+toD		Silty clay loam	Weak					
		E	7′·0	580	N	Khaki slate	Silty clay loam	D to W			Strong					
58	460′W. & 20′N. of 8-282	A	0′·5	520	N	Brown slate	Clay loam	M−	Clay loam		None	55·39	52·84	41·19	Below 45·84	No
		B	1′·5	520	N	Khaki slate	Clay loam	M−			Weak					
		C	3′·0	832	N	Light khaki slate	Sandy clay	M−			Strong					
		D	5′·0	832	N	Light khaki slate	Sandy clay	M		Sandy clay	Strong					
		E	7′·0	416	N	Light khaki slate	Sandy clay	M+			Strong					
57	210′N. of 8-283	A	0′·5	374	W	Brown slate	Peaty silt	M−	Silty peat		None	53·21	51·91	45·11	45·41	No
		B	1′·5	208	W	Light brown slate	Silty peat	M−			None					
		C	3′·0	224	W	Dark brown slate	Silty peat	M+			None					
		D	5′·0	499	N	Blue grey	Silty clay loam	M+		Silty clay loam	None					
		E	7′·0	780	N	Blue grey	Sandy clay	D−			Strong					
41	575′W. & 50′N. of 9-161	A	0′·5	229	W	Light slate	Silty peat	M−	Peaty silt		Strong	55·71	51·07	44·31	44·07 (Kerr L. = 47·07)	No
		B	1′·5	332	W	Light slate	Peaty silt	M			Weak					
		C	3′·0	499	N	Light yellow slate	Clay loam	M+			None					
		D	5′·0	960	N	Khaki slate	Silt loam	M+toD		Loam	None					
		E	7′·0	1,302	N	Blue grey	Sandy loam	D to W			Strong					
42	600′E. & 350′S. of 9-169	A	0′·5	643	N	Yellow slate	Loam	M−	Clay loam		None	63·43	52·15	43·23	Below 45·15	No
		B	1′·5	1,124	N	Dark khaki	Clay loam	M			None					
		C	3′·0	1,196	N	Light khaki	Silt loam	M+			Weak					
		D	5′·0	1,808	N	Light khaki	Silt loam	D−		Silt loam	Strong					
		E	7′·0	2,498	N	Light khaki	Silt loam	D+			Strong					

APPENDIX 2—*Continued*

Idaho Soil Samples, 1930

Group No.	Location	Sample	Depth	Resistance in Ohms	Alkalinity	Color (wet)	Material	Moisture	General Type 0-3′	General Type 3-7′	Amount of $CaCO_3$ by HCl. test	Top of pipe	Ground L. at group	W.L. in well	W.L. at group	Samples for analysis
40	170′W. & 30′N.	A	0′·5	886	N	Slate	Clay loam	M−	Silty clay		None	57·21	52·61	45·06	45·20	No
	of 9-170	B	1′·5	1,216	N	Red brown slate	Silty clay loam	M	loam		None					
		C	3′·0	1,248	N	Dark yellow khaki	Silty clay loam	M+			Weak					
		D	5′·0	2,148	N	Dark yellow khaki	Loam	D		Loam	Strong					
		E	7′·0	1,897	N	Light yellow khaki	Fine sandy loam	W			Strong					
39	300′W. & 100′N.	A	0′·5	790	N	Dark yellow grey	Silt loam	M−	Silt loam		None	57·21	57·81	45·06	Below	No
	of 9-170	B	1′·5	822	N	Light yellow grey	Loam	M			None				50·81	
		C	3′·0	1,356	N	Dark khaki	Sandy loam	M			Strong					
		D	5′·0	1,951	N	Light khaki	Sandy loam	M+		Sandy	Strong					
		E	7′·0	2,259	N	Light khaki	Sandy loam	M+		loam	Strong					
37	200′W. & 150′S.	A	0′·5	973	N	Slate	Clay loam	M	Clay loam		None	54·83	51·96	45·03	45·16	Yes
	of 9-171	B	1′·5	1,300	N	Khaki grey	Clay loam	M−			None					
		C	3′·0	1,695	N	Light khaki grey	Clay loam	M+			None					
		D	5′·0	1,613	N	Dark khaki grey	Sandy clay	D to W		Fine	None					
		E	7′·0	2,964	N	Dark khaki grey	Fine sand	W		sandy loam	Weak					
38	190′W. of 9-171.	A	0′·5	1,092	N	Slate	Clay loam	M−	Clay loam		None	54·83	55·38	45·03	45·20	No
		B	1′·5	1,130	N	Yellow slate	Clay loam	M−			None					
		C	3′·0	1,438	N	Light khaki	Silt loam	M			Strong					
		D	5′·0	2,444	N	Light khaki	Sandy clay	D−		Sandy	Strong					
		E	7′·0	2,568	N	Dark khaki	Fine sandy loam	D+		clay	Strong					
53	142′W. of 10-229	A	0′·5	470	N	Light slate	Clay, loam & humus	M	Clayey		Weak	55·04	52·31	48·94	About	No
		B	1′·5	749	N	Brown slate	Clayey peat	M+	peat		None				49·00	
		C	3′·0	499	N	Yellow slate	Peaty clay	D−			None					
		D	5′·0	851	N	Brown slate	Silty clay loam	D+		Silty clay	None					
		E	7′·0	912	N	Brown slate	Silty clay loam	W		loam	None					
52	320′W. of 10-230	A	0′·5	354	W	Dark khaki slate	Loam	M−	Clay loam		Strong	56·52	53·40	36·42	Below	No
		B	1′·5	380	W	Dark khaki slate	Clay loam	M			None				46·40	
		C	3′·0	603	N	Light khaki slate	Clay loam	M+			Strong					
		D	5′·0	637	N	Light khaki slate	Silt loam	D−		Silt loam	Strong					
		E	7′·0	728	N	Light khaki slate	Silt loam	D−			Strong					
65	1,050′E. of 11-67	A	0′·5	759	N	Dark khaki slate	Silt loam	M−	Silt loam		Strong	57·71	63·09	48·71	Below	No
		B	1′·5	742	N	Light khaki slate	Silt loam	M−			Strong				57·09	
		C	3′·0	1,576	N	Light khaki slate	Sandy silt	M			Strong					
		D	5′·0	2,194	N	Light khaki slate	Sandy silt	M		Sandy	Strong					
		E	7′·0	2,266	N	Light khaki slate	Sandy silt	M		silt	Strong					

56	3,000′S. & 600′E.	A	0′·5	520	N	Yellow slate	Sandy clay	M	Sandy		Strong	61·13	58·34	44·60	Below	Yes
	of 11-69	B	1′·5	873	N	Light yellow slate	Sandy clay	M−	clay		Strong			at 11-69	51·34	
		C	3′·0	739	N	Light yellow slate	Sandy clay	M		Silty clay	Strong			43·02 at		
		D	5′·0	852	N	Light yellow slate	Clay loam	D		loam	Strong			11-68		
		E	7′·0	822	N	Light yellow slate	Silty clay loam	W			Weak					
20	1,315′W. & 260′N.	A	0′·5	373	W	Brown slate	Silty peat	M	Silty peat		Strong	57·75	55·72	Below	50·82	Yes
	of 11-93A	B	1′·5	431	N	Brown slate	Silty peat	M+			None			50·75		
		C	3′·0	359	W	Light brown slate	Peaty silt	D−			None					
		D	5′·0	277	W	Light brown slate	Peaty silt	D−		Silt loam	None					
		E	7′·0	534	N	Khaki grey	Silt loam	W			Strong					
51	150′E. of 12-	A	0′·5	520	N	Brown	Peat	M	Silty peat		None	56·42	55·62	47·92	Below	No
	126A	B	1′·5	900	N	Brown	Silty peat	M			None				48·62	
		C	3′·0	1,145	N	Brown slate	Peaty silt	M+			None					
		D	5′·0	830	N	Light brown slate	Clay loam	D−		Clay loam	None					
		E	7′·0	540	N	Dark brown slate	Clay loam	D			None					
50	150′W. & 220′S.	A	0′·5	1,634	N	Brown slate	Sandy loam	M−	Sandy		Strong	62·87	61·42	46·37	Below	No
	of 12-127	B	1′·5	1,206	N	Light brown slate	Sandy loam	M−	loam		Strong				54·42	
		C	3′·0	1,287	N	Dark khaki slate	Fine sandy loam	M			Strong					
		D	5′·0	1,337	N	Light khaki slate	Loam	M		Silt loam	Strong					
		E	7′·0	1,317	N	Light khaki slate	Silt loam	M+								

Appendix 2—*Continued*

SOIL SAMPLES FROM DEEP WELLS OF U.S.R.S. IN KOOTENAY FLATS, IDAHO

Group Well	Location of Well	Depth	Ohms	Alkalinity	Color (wet)	Material	Amount of CaCo³ by Hcl. test	Remarks
24	5-119	0′-1′	288	W	Brown slate	Sandy loam	Strong	
23	5-119	4′·5	322	W	Light blue grey	Sandy clay	None	
21	5-119	9·0	679	N	Blue grey	Fine sand	Strong	
30	6-209A	9·5	770	N	Blue khaki	Clay loam	Strong	
29	6-209A	9–14	562	N	Blue khaki	Silty clay loam	Strong	
2	6-219	0–1	179	M.S.	Brown slate	Clay loam	Strong	
1	6-219	1–20	800	N	Dark khaki	Very fine sand	Strong	Shells
3	6-219	20–23	291	W	Blue	Clayey sand	Strong	
22	8-252	0–8	569	N	Dark khaki	Fine sandy loam	Strong	
26	8-252	8·22	1,081	N	Dark khaki	Silt loam	Strong	
25	8-252	22–25	1,334	N	Slate	Clayey sand	Strong	
28	8-269A	5–10	978	N	Blue khaki	Silty clay loam	Strong	
27	8-269A	10–20	530	N	Blue khaki	Silty clay loam	Strong	
11	9-153	0–4	1,078	N	Dark khaki slate	Sandy loam	Strong	
5	9-153	4–13	2,392	N	Dark khaki	Very fine sand	Strong	
9	9-153	13–17	1,737	N	Light khaki	Silt loam	Strong	
12	9-153	17–27	1,269	N	Light khaki	Silty clay loam	Strong	
7	9-153	27–32	1,248	N	Light khaki	Silty clay loam	Weak	
18	9-162	0–11	2,215	N	Very dark khaki	Sandy clay	Strong	
19	9-162	11–8	2,245	N	Very dark khaki	Sandy clay	Strong	
17	9-172	0–8	1,302	N	Very dark khaki	Sandy loam	Strong	
16	9-172	8–17	2,273	N	Dark khaki	Sandy loam	Strong	
15	9-172	13–19	2,392	N	Yellow khaki slate	Sandy loam	Strong	
14	9-172	19–24	1,768	N	Khaki slate	Silty clay loam	Strong	
13	9-172	24–29	307	W	Blue slate	Sandy clay	Strong	
4	10-206	0–8	1,820	N	Dark brown	Peat	None	
10	10-218	0–5	416	N	Dark khaki slate	Fine sandy loam	Strong	
6	10-218	5–10	406	N	Brown slate	Peaty silt	None	
8	10-218	7–19	603	N	Khaki grey	Silty clay	Strong	
31	U-187	6–16	1,144	N	Dark khaki	Sandy loam	Strong	
20	U-187	16–18	697	N	Blue slate	Sandy clay	Strong	

WATER SAMPLES

Water								
1	Drain ditch near 4-147A	....	422	N	....	....	....	Still water.
2	Pump sump near 6-242	....	943	N	....	....	....	No water draining through outlet into river.
3	Lake east of 8-261	....	744	N	....	....	....	SE. corner of District 8.
4	Kootenay river at Inter. Bdy	....	1,100	N	....	....	....	NW. corner of District 1.
5	Drain ditch at main pumphouse near 1-50	....	377	W	....	....	....	Not diluted by possible spring seepage from the south side.
6	Slough in south end of District 1	....	482	N	....	....	....	Wells 1-4 and 1-5 where water drains into the ditch.

Appendix 5

NUMERICAL ANALYSIS OF BRIDGE TESTING RESULTS

Canadian Samples

	Very Negative Over 600 ohms	Negative 600-400 ohms	Very Weak 400-300 ohms	Weak 300-190 ohms	Moderately Strong 190-130 ohms	Strong 130-80 ohms	Very Strong Below 80 ohms
A Skim—							
0″ ·25	.....	.....	.....	1	1	.....	.....
A 0′ ·5	7	.....	2	.....	.....	.....	.....
B 1′ ·5	7	2	.....	.....	.....	.....	.....
C 3′ ·0	9	.....	.....	.....	.....	.....	.....
D 5′ ·0	8	1	.....	.....	.....	.....	.....
E 7′ ·0	8	1	.....	.....	.....	.....	.....
Total	39	4	2	1	1	.....	.....

9 groups of 47 samples show the following analysis:

	84%	8%	4%	2%	2%		

American Samples

	Very Negative Over 600 ohms	Negative 600-400 ohms	Very Weak 400-300 ohms	Weak 300-190 ohms	Moderately Strong 190-130 ohms	Strong 130-80 ohms	Very Strong Below 80 ohms
A Skim—							
0 ·25	.....	.....	.....	.....	3	2	1
A 0′ ·5	21	13	10	11	.....	.....	1
B 1′ ·5	28	9	11	6	.....	.....	.....
C 3′ ·0	29	14	4	8	.....	.....	.....
D 5′ ·0	34	13	3	4	.....	.....	.....
E 7′ ·0	41	11	1	1	.....	.....	.....
F 10′ ·0	3	.....	.....	.....	.....	.....	.....
G 15′ ·0	2	.....	.....	.....	.....	.....	.....
H 20′ ·0	2	.....	.....	.....	.....	.....	.....
Total	160	60	29	30	3	2	2

56 groups of 286 samples show the following analysis:

	56%	21%	10%	10%	1%	1%	1%

Appendix 7

CLASSIFICATION OF SOIL MATERIALS OF UNITED STATES BUREAU OF SOILS

Soils containing −20 silt and clay:
- Coarse sand ..... 25 + fine gravel, and coarse sand, and less than 50 any other grade.
- Sand ..... 25 + fine gravel, coarse and medium sand, and less than 50 fine sand.
- Fine sand ..... 50 + fine sand, or −25 fine gravel, coarse and medium sand, 50 + very fine sand.
- Very fine sand ..... 50 + very fine sand.

Soils containing 20-50 silt and clay:
- Sandy loam ..... 25 + fine gravel, coarse and medium sand.
- Fine sandy loam ..... 50 + fine sand, or −25 fine gravel, coarse and medium sand.
- Sandy clay ..... 20 silt.

Soils containing 50 + silt and clay:
- Loam ..... 20 clay, −50 silt.
- Silt loam ..... 20 clay, 50 + silt.
- Clay loam ..... 20-30 clay, −50 silt.
- Silty clay loam ..... 20-30 clay, 50 + silt.
- Clay ..... 30 + clay.

Appendix 8a

SOIL INVESTIGATION

To the Commissioner of Irrigation,
Calgary, Alberta.

Report upon the Chemical Analysis of Soil Group No. 20C. Collected on October, 1930.
Purpose.. .. ..

Location.. .. .. .. ¼ Sec.. .. .. .. tp.. .. .. .. rge.. .. .. .. W. of.. .. M.. .. ..

Kootenay Valley, Idaho District.

WATER SOLUBLE CONSTITUENTS

Results expressed as percentages of air-dried soils.

Field Sample Letter	A	B	C	D	E
Laboratory number	....	....	....	....	....
Depth	....	....	....	....	....
Water-soluble content at 105°C	....	....	·494	....	....
Loss on ignition	....	....	·107	....	....
Solids after ignition	....	....	·387	....	....
Lime (CaO)	....	....	·115	....	....
Magnesia (Mg O)	....	....	·041	....	....
*Alkalies (Na_2O)	....	....	·003	....	....
Sulphates (SO_3)	....	....	·167	....	....
Chlorides (Cl.)	....	....	·002	....	....
—Carbonates (CO_2)	....	....	·097	....	....
Total by addition	....	....	·328	....	....
Reaction of Solution. P h					

*Not determined, percentage obtained by difference. —All bi-carbonates.

SOIL INVESTIGATION

To the Commissioner of Irrigation,
Calgary, Alberta.

Report upon the Chemical Analysis of Soil Group No. 26. Collected on October, 1930..
Purpose.. .. ..

Location.. .. .. .. ¼ Sec.. .. .. .. tp.. .. .. .. rge.. .. .. .. W. of.. .. M.. .. ..

Kootenay Valley, Idaho District.

WATER SOLUBLE CONSTITUENTS

Results expressed as percentages of air-dried soils.

Field Sample Letter	A	B	C	D	H
Laboratory number	....	....	....	....	....
Depth	....	....	....	....	....
Water soluble content at 105° C	....	·532	....	·207	·490
Loss on ignition	....	·104	....	·045	·169
Solids after ignition	....	·428	....	·162	·321
Lime (Ca O)	....	·163	....	·075	·115
Magnesia (Mg O)	....	·038	....	·022	·041
*Alkalies (NA_2O)	....	·000	....	·008	·011
Sulphates (SO_3)	....	·200	....	·047	·185
Chlorides (Cl.)	....	·004	....	·003	·004
-Carbonates (CO_2)	....	·100	....	·100	·076
Total by addition	....	·405	....	·155	·356
Reaction of Solution P h					

*Not determined, percentage obtained by difference. -All bi-carbonates.

APPENDIX 8a—*Continued*

SOIL INVESTIGATION

To the Commissioner of Irrigation,
Calgary, Alberta.

Report upon the Chemical Analysis of Soil Group No. 27. Collected on October, 1930.
Purpose.. .. ..

Location.. .. .. ¼ Sec.. .. .. tp.. .. .. rge.. .. .. W. of.. .. M.. .. ..
Kootenay Valley, Idaho District.

WATER SOLUBLE CONSTITUENTS

Results expressed as percentages of air-dried soils.

Field Sample Letter	A	B	C	D	E
Laboratory number					
Depth					
Water-soluble content at 105° C.					·238
Loss on ignition					·048
Solids after ignition					·190
Lime (Ca O)					·033
Magnesia (Mg O)					·053
*Alkalies (NA_2O)					·015
Sulphates (SO_3)					·090
Chlorides (Cl.)					·003
–Carbonates (CO_2)					·069
Total by addition					·194
Reaction of solution Ph					

*Not determined, percentage obtained by difference. –All bi-carbonates.

SOIL INVESTIGATION

To the Commissioner of Irrigation,
Calgary, Alberta.

Report upon the Chemical Analysis of Soil Group No. 54. Collected on October, 1930.
Purpose.. .. ..

Location.. .. .. ¼ Sec.. .. .. tp.. .. .. rge.. .. .. W. of.. .. M.. .. ..
Kootenay Valley, Idaho District.

WATER SOLUBLE CONSTITUENTS

Results expressed as percentages of air-dried soils.

Field Sample Letter	A	B	C	D	E
Laboratory number					
Depth					
Water soluble content at 105° C.		·519			
Loss on ignition		·186			
Solids after ignition		·333			
Lime (Ca O)		·145			
Magnesia (Mg O)		·055			
*Alkalies (Na_2O)		·000			
Sulphates (SO_3)		·164			
Chlorides (Cl.)		·002			
-Carbonates (CO_2)		·183			
Total by addition		·366			
Reaction of solution Ph					

*Not determined, percentage obtained by difference. –All bi-carbonates.

APPENDIX 8a—*Continued*

SOIL INVESTIGATION

To the Commissioner of Irrigation,
Calgary, Alberta.

Report upon the Chemical Analysis of Soil Group No. Water 2. Collected on October, 1930.
Purpose.. .. ..

Pump, Sump near well 6-242.
Location.. .. .. .. ¼ Sec.. .. .. .. tp.. .. .. .. rge.. .. .. .. W. of.. .. M.. .. ..
Kootenay Valley, Idaho District.

WATER SOLUBLE CONSTITUENTS

Results expressed as percentages of air-dried soils.

Field Sample Letter—	A	B	C	D	E
Laboratory number	....	....	....	....	....
Depth	....	....	....	....	....
Water-soluble content at 105° C.	·018	....	....	....	....
Loss on ignition	·002	....	....	....	....
Solids after ignition	·016	....	....	....	....
Lime (Ca O)	·005	....	....	....	....
Magnesia (Mg O)	·002	....	....	....	....
*Alkalies (NA_2O)	·007	....	....	....	....
Sulphates (SO_3)	·001	....	....	....	....
Chlorides (Cl.)	Trace	....	....	....	....
–Carbonates (CO_2)	·017	....	....	....	....
Total by addition	·015	....	....	....	....
Reaction of solution Ph	8·3	....	....	....	....

*Not determined, percentage obtained by difference. –All bi-carbonates.

SOIL INVESTIGATION

To the Commissioner of Irrigation,
Calgary, Alberta.

Report upon the Chemical Analysis of Soil Group No. Water 4. Collected on October, 1930.
Purpose.. .. ..

Kootenay River at International Boundary.
Location.. .. .. .. ¼ Sec.. .. .. .. tp.. .. .. .. rge.. .. .. .. W. of.. .. M.. .. ..
Kootenay Valley, Idaho District.

WATER SOLUBLE CONSTITUENTS

Results expressed as percentages of air-dried soils.

Field Sample Letter	A	B	C	D	E
Laboratory number	....	....	....	....	....
Depth	....	....	....	....	....
Water soluble content at 100° C.	·016	....	....	....	....
Loss on ignition	·005	....	....	....	....
Solids after ignition	·011	....	....	....	....
Lime (Ca O)	·006	....	....	....	....
Magnesia (Mg O)	·003	....	....	....	....
*Alkalies (Na_2O)	·000	....	....	....	....
Sulphates (SO_3)	·002	....	....	....	....
Chlorides (Cl.)	Trace	....	....	....	....
–Carbonates (CO_2)	·011	....	....	....	....
Total by addition	·011	....	....	....	....
Reaction of solution Ph	8·4–8·5	....	....	....	....

*Not determined, percentage obtained by difference. –All bi-carbonates.

APPENDIX 8b

CHEMICAL ANALYSIS OF SOILS FROM KOOTENAY FLATS, IDAHO, 1930-31

Analyses made by University of Alberta and Calgary City Chemist.*

a Sample	b Near Well No.	c Sodium Sulphate Na_2SO_4	d Calcium Sulphate $Ca\ SO_4$	e Magnesium Sulphate $Mg\ SO_4$	f $Ca\ Cl_2$, $Mg\ Cl_2$, $Ca(HCO_3)_2$, $Mg(HCO_3)_2$ (by subtraction)	g Total by Addition	h Total Salts less $Ca\ SO_4$	i Solids after Ignition	j Ohms resistance	k % of Salts from Bridge Table
		%	%	%	%	%	%	%		%
26 A	1-8	·012	·377	·037	·046	·472	·095	·451	221	·093
26 B*	1-8	......	·340	......	·095	·405	·095	·428	239	·084
26 C	1-8	·340	·200	·140	·021	·701	·501	·687	242	·082
26 D*	1-8	·018	·063	......	·095	·155	·113	·162	590	·032
26 H*	1-8	·025	·276	·001	·072	·356	·098	·321	697	·027
27 A (skim)	1-12	·285	·113	·050	·105	·553	·440	·521	92	·243
27 A	1-12	·009	·048	......	·030	·087	·039	·065	632	·030
27 E*	1-12	·034	·079	·036	·065	·194	·135	·190	858	·022
21 C	4-143A	·032	·180	·022	·055	·289	·109	·268	370	·054
21 D	4-143A	·094	·374	·046	·063	·577	·203	·567	272	·072
21 E	4-143A	·046	·161	·005	·041	·253	·092	·244	452	·043
54 A	5-118	......	·224	......	·093	·317	·093	·272	348	·057
54 B*	5-118	......	·279	......	·115	·366	·115	·333	333	·059
54 C	5-118	·166	·456	·033	·073	·728	·272	·721	244	·082
54 D	5-118	·136	·384	·120	·069	·709	·325	·694	192	·109
54 E	5-118	·016	·262	·171	·040	·489	·227	·473	224	·092
32 A	6-190	·078	·019	......	·102	·199	·180	·178	295	·067
32 B	6-190	·041	·003	......	·084	·128	·125	·107	374	·053
22 A	6-213	·083	·156	......	·090	·329	·173	·307	232	·087
22 B	6-213	......	·120	......	·078	·198	·078	·178	272	·072
29 A (skim)	7-62	·092	·338	·208	·065	·703	·365	·686	132	·164
29 A	7-62	......	·103	·009	·031	·143	·040	·129	390	·050
59 A	8-268	·014	·182	......	·104	·300	·118	·262	350	·057
59 C	8-268	......	·782	·057	·079	·918	·136	·898	246	·081
59 D	8-268	·007	·083	......	·040	·130	·047	·107	420	·046
20 A	11-93 A	·016	·143	......	·070	·229	·086	·208	373	·053
20 C*	11-93 A	·007	·284	......	·093	·328	·100	·387	359	·056
20 D	11-93 A	......	·401	·112	·062	·575	·174	·538	277	·070
Aggregates	......	1·551	6·430	1·047	1·976	10·831	4·574	10·382	9,726	2·037
Averages([1])	......	·055	·230	·037	·071	·386	·163	·371	347	·073
Water Samples:										
1	4-147A	·004	......	......	·065	·069	·069	·028	422	·046
2*	6-242	·002	......	......	·015	·015	·015	·016	943	·019
4*	K.R. at Int'l Bdy.	......	·003	......	·009	·011	·008	·011	1,100	·016
5	1-50	·009	·014	......	·047	·070	·056	·040	377	·053
6	Dist. 1	·006	......	......	·052	·058	·058	·026	482	·040

[1] The difference in balance between the addition of columns c, d, e, and f (0·393) versus column g (0·386) in these averages is due to a difference in the method of calculating the values in column (f) in the case of samples marked with an asterisk. In the case of these samples (obtained by the Calgary city chemist) the figures for chlorides and bi-carbonates of calcium and magnesium were determined by ionic balance and not by difference.

Q

RESPONSE

To the Amended Application of West Kootenay Power and Light Company, Limited, for Approval of the Construction of a Storage Dam and Compensating Works and Plans therefor in the Kootenay River at or near Granite and Corra Linn, British Columbia, all hereinafter referred to as "Respondents."

To the Honorable, the International Joint Commission, Ottawa, Canada, and Washington, D.C.

The undersigned, as Solicitors for Honorable C. Ben Ross, Governor of the State of Idaho, on the relationship of the State of Idaho, and Drainage Districts Nos. 1 to 13, both numbers inclusive, of the County of Boundary in the State of Idaho, with the consent of the Government of the United States of America first having been obtained, respectfully say in response to the amended application of the West Kootenay Power and Light Company, Limited, as follows:—

I

That the respondent, State of Idaho, is one of the states of the United States of America, and Honorable C. Ben Ross is the duly elected, qualified and acting Governor of said state, and the respondents, Drainage Districts Nos. 1 to 13, both numbers inclusive, of the County of Boundary in the State of Idaho, are duly organized and existing quasi-municipal corporations of the State of Idaho controlling, maintaining and operating approximately 30,000 acres of highly developed and exceedingly valuable agricultural land along the Kootenay river between Bonners Ferry, Idaho, United States of America, and the international boundary line between the United States of America and the Dominion of Canada, at Porthill, Idaho.

II

That the West Kootenay Power and Light Company, Limited, hereinafter called the "Company," is a corporation chartered by special act of the Province of British Columbia, Canada, being Chapter 63 of the Statutes of British Columbia, 1897, and the amendments thereto, being found in Chapter 78 of the Statutes of British Columbia, 1911, and Chapter 76 of the Statutes of British Columbia, 1929, and said company is authorized to acquire and hold water licences and develop and sell power therefrom, and do all things necessary or incidental thereto.

III

That in the year 1932 the said company filed with the Honorable, the International Joint Commission, "Amended Application of West Kootenay Power and Light Company, Limited, to the International Joint Commission for approval of works in the Kootenay River and for the right to store water in the Kootenay Lake" at Granite and at Corra Linn, reference to said amended application being hereby expressly made.

IV

Replying to paragraph (6) of said amended application of said company the respondents herein deny that the flow in the Kootenay river varies from average high water of one hundred and seven thousand (107,000) cubic feet per second in summer months to four thousand eight hundred (4,800) cubic feet per second in the winter months; and deny that during the months of November, December, January, February and March of each year the water flowing in said Kootenay river is frequently insufficient to operate the two larger plants of the company at not to exceed fifty per cent capacity.

V

Replying to paragraph (7) of said amended application of said company the respondents herein deny that by confining the Kootenay river to its normal low water channel between earthen dikes that said river is deprived of its natural reservoir facilities with the result that in low water period the average flow of the river has been reduced, or that in the high water period the average flow has been increased, or that the company as a result thereof, or at all, is deprived of a considerable portion of the former average minimum flow of said river, or that the amount of power which the company is able to develop in the low water periods is in anywise affected, or is in any manner changed from what it would be were said Kootenay river not confined between earthen dikes mentioned in said paragraph.

VI

Replying to paragraph (8) of said amended application of said company the respondents herein admit that the company now has an application dated September 6, 1929, before the International Joint Commission for the approval of the construction of a storage dam and compensating works in the Kootenay river at or near Granite, B.C., and that a public hearing in connection therewith has been held by said Commission at Bonners Ferry, Idaho, and this response to the amended application is hereby made to apply as a response to said original application to the same effect and in the same manner as though said original application were the only application of the company on file or for consideration in the premises.

VII

Replying to paragraph (9) of said amended application of said company the respondents herein deny that The Consolidated Mining and Smelting Company of Canada, Limited, has undertaken to the International Joint Commission in certain proceedings before said Commission to construct extensive sulphuric acid and fertilizer plants at Trail, B.C., to utilize the sulphur gases coming from its smelter to relieve the, or any, situation that has arisen in consequence of its said gases drifting over the international boundary line, and resulting in claims for damages by residents of the State of Washington or elsewhere; and deny that it was the intention or undertaking of said Consolidated Mining and Smelting Company of Canada, Limited, that its said plants would be in operation by August or September of the year 1931; and deny that the electric power necessary and required in the operation of the plant, or any plants of the said Consolidated Mining and Smelting Company of Canada, Limited, is not available or can not be had unless the company increases its production of electrical power by and through the storage of water in Kootenay lake, or by and through the erection of another power plant to supply electric power with which to operate the said plant of the said Consolidated Mining and Smelting Company of Canada, Limited.

VIII

Replying to paragraph (10) of said amended application of said company the respondents have insufficient knowledge upon which to base a positive denial, but basing their denial upon information and belief respondents deny that the company commenced the construction of a power dam and power plant at Corra Linn, B.C., on the Kootenay river about five (5) miles below the site of the storage dam proposed to be constructed at Granite, B.C., as mentioned in the original application to said Commission, and deny that said dam was completed about the 10th day of October, 1931, or that it is now completed; and likewise upon information and belief the respondents deny that any power plant at Corra Linn, B.C., has been completed or that the company expects to complete any power plant thereat.

IX

Replying to paragraph (11) of said amended application of said company the respondents deny that said, or any dam at Corra Linn, B.C., is, or has been constructed in such manner that it can be operated efficiently and solely as a power dam without raising the level of the river at the international boundary line; and allege the facts to be that the construction or operation of any dam at Corra Linn, B.C., will result in the storage of water in Kootenay lake, as requested in the company's original application, and that by so constructing or operating said dam the water level of Kootenay river would be raised at the international boundary line. Admit that the consent of the International Joint Commission is necessary to the construction and operation of said dam as a storage dam under and pursuant to Article IV of the Treaty of January 11, 1909, between the United States of America and Great Britain.

X

Replying to paragraph (12) of said amended application of said company respondents herein deny that the company has removed from the bed and banks of the Kootenay river at or near Granite, B.C., large quantities of rock and gravel to facilitate the free flow of the water of Kootenay river at a point above, or at a point below said Granite, B.C., and likewise deny that the effect will be to lower the water in Kootenay lake during the high water season, or at any other time, or at all.

XI

Replying to paragraph (15) of said amended application of said company respondents herein deny that the construction of the proposed, or any dam at Corra Linn, B.C., will not increase the natural elevation of the waters in Kootenay lake or Kootenay river at the international boundary line; and allege the facts to be that the construction of any such contemplated dam at Corra Linn will increase the elevation of the waters in Kootenay lake and Kootenay river at the international boundary line above the natural stage, and further allege that the object and purpose of the construction of said contemplated dam at Corra Linn is to increase the waters in Kootenay lake and Kootenay river for storage purposes, in order to furnish an increased flow for power purposes at Corra Linn and elsewhere below Corra Linn on said Kootenay river where said company has constructed and is operating other power plants.

XII

Replying to paragraph (20) of said amended application of said company respondents herein deny that the completion of the works of said proposed dam at Corra Linn, and or the method of operation thereof by the company will not have an injurious effect on any interests in the United States or any state thereof; and deny that the completion of said proposed works and the operation of said proposed dam will make it possible to decrease the high water levels at the international boundary line and beyond it, to the benefit of all interests in the United States and particularly to all interests in the State of Idaho, and is a benefit now being sought by said interests. Allege the facts to be that the operation of said dam as proposed will increase the water levels at the international boundary line and beyond it in such manner and to such extent that it will be damaging and detrimental to these respondents, in that it will saturate and water-log the lands within the hereinbefore mentioned districts.

As an affirmative defense and resistance to the amended application of the West Kootenay Power and Light Company, Limited, the respondents herein allege:—

I

That under and by virtue of a treaty between the United States and Great Britain, relating to boundary waters and questions arising between the United States and Canada, which treaty was signed January 11, 1909, ratified May 5, 1909, and became effective May 13, 1910, and still remains in full force, power and effect as originally entered, it is provided among other things as follows:—

"ARTICLE II

"Each of the High Contracting Parties reserves to itself or to the several State Governments on the one side and the Dominion or Provincial Governments on the other as the case may be, subject to any treaty provisions now existing with respect thereto, the exclusive jurisdiction and control over the use and diversion, whether temporary or permanent, of all waters on its own side of the line which in their natural channels would flow across the boundary or into boundary waters; but it is agreed that any interference with or diversion from their natural channel of such waters on either side of the boundary, resulting in any injury on the other side of the boundary, shall give rise to the same rights and entitle the injured parties to the same legal remedies as if such injury took place in the country where such diversion or interference occurs; but this provision shall not apply to cases already existing or to cases expressly covered by special agreement between the parties hereto.

"It is understood, however, that neither of the High Contracting Parties intends by the foregoing provision to surrender any right, which it may have, to object to any interference with or diversions of waters on the other side of the boundary the effect of which would be productive of material injury to the navigation interests on its own side of the boundary.

"ARTICLE III

"It is agreed that, in addition to the uses, obstructions, and diversions heretofore permitted or hereafter provided for by special agreement between the Parties hereto, no further or other uses or obstructions or diversions, whether temporary or permanent, of boundary waters on either side of the line, affecting the natural level or flow of boundary waters on the other side of the line, shall be made except by authority of the United States

or the Dominion of Canada within their respective jurisdictions and with the approval, as hereinafter provided, of a joint commission, to be known as the International Joint Commission.

"The foregoing provisions are not intended to limit or interfere with the existing rights of the Government of the United States on the one side and the Government of the Dominion of Canada on the other, to undertake and carry on governmental works in boundary waters for the deepening of channels, the construction of breakwaters, the improvement of harbours, and other governmental works for the benefit of commerce and navigation, provided that such works are wholly on its own side of the line, and do not materially affect the level of flow of the boundary waters on the other, nor are such provisions intended to interfere with the ordinary use of such waters for domestic and sanitary purposes.

"ARTICLE IV

"The High Contracting Parties agree that, except in cases provided for by special agreement between them, they will not permit the construction or maintenance on their respective sides of the boundary of any remedial or protective works or any dams or other obstructions in waters flowing from boundary waters or in waters at a lower level than the boundary, in rivers flowing across the boundary, the effect of which is to raise the natural level of waters on the other side of the boundary unless the construction or maintenance thereof is approved by the aforesaid International Joint Commission.

"It is further agreed that the waters herein defined as boundary waters and waters flowing across the boundary shall not be polluted on either side to the injury of health or property on the other.

"ARTICLE VIII

"This International Joint Commission shall have jurisdiction over and shall pass upon all cases involving the use or obstruction or diversion of the waters with respect to which under Articles III and IV of this treaty the approval of this Commission is required, and in passing upon such cases the Commission shall be governed by the following rules or principles which are adopted by the High Contracting Parties for this purpose:—

"The High Contracting Parties shall have, each on its own side of the boundary, equal and similar rights in the use of the waters hereinbefore defined as boundary waters.

"The following order of precedence shall be observed among the various uses enumerated hereinafter for these waters, and no use shall be permitted which tends materially to conflict with or restrain any other use which is given preference over it in this order of precedence:—

"(1) Uses for domestic and sanitary purposes;

"(2) Uses for navigation, including the service of canals for the purposes of navigation;

"(3) Uses for power and for irrigation purposes.

"The foregoing provisions shall not apply to or disturb any existing uses of boundary waters on either side of the boundary.

"The requirement for an equal division may in the discretion of the Commission be suspended in cases of temporary diversions along boundary waters at points where such equal division can not be made advantageously on account of local conditions, and where such diversion does not diminish elsewhere the amount available for use on the other side.

"The Commission in its discretion may make its approval in any case conditional upon the construction of remedial or protective works to compensate so far as possible for the particular use or diversion proposed, and in such cases may require that suitable and adequate provision, approved by the Commission, be made for the protection and indemnity against injury of any interests on either side of the boundary.

"In cases involving the elevation of the natural level of waters on either side of the line as a result of the construction or maintenance on the other side of remedial or protective works or dams or other obstructions in boundary waters or in waters flowing therefrom or in waters below the boundary in rivers flowing across the boundary, the Commission shall require, as a condition of its approval thereof, that suitable and adequate provision, approved by it, be made for the protection and indemnity of all interests on the other side of the line which may be injured thereby.

"The majority of the Commissioners shall have power to render a decision. In case the Commission is evenly divided upon any question or matter presented to it for decision, separate reports shall be made by the Commissioners on each side to their own Government. The High Contracting Parties shall endeavour to agree upon an adjustment of the question or matter of difference, and if an agreement is reached between them, it shall be reduced to writing in the form of a protocol, and shall be communicated to the Commissioners, who shall take such further proceedings as may be necessary to carry out such agreement."

II

That in disregard of the above mentioned treaty and in flagrant violation thereof, and with absolute disregard of the moral obligations due and owing to the Honorable, the International Joint Commission, and the respondents herein, in connection therewith, and with utter disregard of the legal obligations imposed by virtue of said treaty and with absolute and apparently intentional bad faith in its conduct to and toward the Honorable, the International Joint Commission, and the respondents herein, and while the said application of the Company for permission to construct and operate certain permanent works in and adjacent to the channel of the Kootenay river, for storage purposes, at Granite, British Columbia, referred to in paragraph III hereof, was pending before the Honorable, the International Joint Commission, and before any order of the Commission in accordance with the prayer of said application had been made or entered, the said company has constructed a dam on the Kootenay river at Corra Linn, British Columbia, at a point about six miles below Granite, British Columbia, where the company originally petitioned for a permit to construct a dam, said Corra Linn being near the outlet of the west arm of Kootenay lake in British Columbia.

III

That the effect of operating the said dams, as mentioned and described in said Amended Application, so as to create and secure the storage sought by said company, will maintain the level of Kootenay lake and the Kootenay river at the International boundary line at a much increased higher stage during the low water period, and because thereof and the obstruction caused thereby the water level within said drainage districts will not recede to the

level it otherwise would recede during the low water season but for said obstructions placed in said Kootenay river by said company, and because thereof said lands will become saturated and water-logged and will become unsanitary and worthless.

IV

That said dam constructed by said company has raised the water in the Kootenay river in Idaho, in the United States of America, at the international boundary line and south therefrom, more than two feet above the normal and natural low water level, and has retarded and obstructed the flow of water in Kootenay river; has used up the natural storage capacity of Kootenay lake, and has raised the water table in the agricultural lands of the respondents to such an extent that the lands have become saturated and water-logged, and has prevented the water from draining from said agricultural lands and prevented the tilling of the soil, and has caused the loss of subsurface storage of water at the high water stage of the Kootenay river, which is one of the necessary factors in preventing the overflow of the Kootenay river upon said land during the flood season.

V

That the present storage of said water in Kootenay lake, caused by the illegal act of the company in constructing said dam in direct and flagrant violation of the said treaty, referred to in paragraph IV hereof, and in utter and flagrant disregard and violation of the order of the Honorable, the International Joint Commission, continuing said hearing, will result in the flood stage of the Kootenay river being increased to such a height that there is grave danger that it will top and destroy the valuable reclamation projects of the respondents, and absolutely and totally prevent any cultivation whatsoever of the valuable agricultural lands of respondents in the State of Idaho, within the United States of America.

VI

That unless the water now stored in Kootenay lake by the company is immediately released and said lake returned to its normal low level, irreparable damage will be caused to the respondents as there is not sufficient storage facilities to handle the flood waters in the coming seasons, as the natural storage capacity of Kootenay lake has been one of the necessary and essential saving factors which has prevented overflows in the past, and it is necessary that the respondents have immediate relief as it will be a physical impossibility for flood waters to be discharged from Kootenay lake within time to furnish relief to the respondents unless an order is made by this Commission directing said company to forthwith release said stored waters and lower the level of Kootenay lake to its natural state.

VII

That the agricultural lands included within said drainage districts numbered 1 to 13, inclusive, are capable of and are now producing and will, if permitted, continue to produce valuable agricultural crops and said lands constitute the main source of revenue and principal support and upkeep of the city of Bonners Ferry and other communities within the County of Boundary,

State of Idaho, and that the resulting damage and loss that will ensue to said communities in the event the application, or applications, of the West Kootenay Power and Light Company, Limited, is or are granted, will be irreparable and is not compensatable.

Wherefore, your respondents pray that the Honorable, the International Joint Commission, forthwith, order said West Kootenay Power and Light Company, Limited, to drain from Kootenay lake the water stored by it and lower the level of Kootenay lake to its natural state, and that said company be required to forthwith remove any and all obstructions placed by it in the Kootenay river or Kootenay lake in violation of said Treaty.

BERT H. MILLER,
Attorney-General of Idaho,
Residence and Post Office, Boise,
Idaho.

O. C. WILSON,
Residence and Post Office,
Bonners Ferry, Idaho,
Attorneys for Respondents.

R

LIST OF EXHIBITS, CORRA LINN DAM HEARING AT NELSON, AUGUST, 1933

Joint Government Exhibit No. 1

Kootenay Lake and River Studies. Summarization of hydraulic studies carried on by the United States Geological Survey and the Dominion Water Power and Hydrometric Bureau in respect to the Application of the West Kootenay Power and Light Company, Limited, to the International Joint Commission for approval of storage privileges in Kootenay Lake. Joint Report by N. C. Grover, U.S. Geological Survey, and J. T. Johnston, Dominion Water Power and Hydrometric Bureau. August 5, 1933.

Canadian Government Exhibits

Exhibit 1—Kootenay Lake and River Studies; volume 1, compiled by J. T. Johnston. June 1, 1933.

Exhibit 2—Kootenay Lake and River Studies, volume 2, compiled by A. J. Matheson and T. M. Patterson. 1933.

Exhibit 3—Memorandum dated August 17, 1933, by T. M. Patterson and A. J. Matheson *re* Actual and Proposed Betterment on Kootenay Lake and on Kootenay River at international boundary and at flooded districts during 1933 flood season.

Exhibit 4—Memorandum *re* High Water, 1933, Kootenay Reclamation Districts, Idaho, by C. E. Webb. (With photographs.)

Exhibit 5—Review of Earlier Investigations made into the Reclamation of Kootenay Flats, by J. T. Johnston. April 27, 1933.

Exhibit 6—Plan of Columbia River Drainage Basin showing location of developed and proposed power sites to be benefited by Kootenay Lake storage regulation.

Exhibit 7—Profile of Kootenay and Columbia Rivers from Kootenay Lake to Pacific Ocean, showing developed and proposed power sites.

Exhibit 8—Report of Engineers of the United States War Department on Preliminary Examination of Kootenai River, Idaho, with a view to the control of its floods. (House Document No. 157, 72d Congress, 1st Session.)

Exhibit 9—Text of Ground Water Studies in Kootenay Flats by V. Meek and S. G. Dawson, dated May 26, 1933.

Exhibit 10—Hydrographs to accompany Report on Ground Water Studies in Kootenay Flats.

Exhibit 11—Table plan to accompany Report on Ground Water Studies in Kootenay Flats.

Exhibit 12—Report on Soil Conditions in Kootenay Valley, B.C., and Idaho, U.S.A., by P. A. Fetterly. February 20, 1932.

Exhibit 13—Representations made on behalf of Department of Indian Affairs (Canada).

United States Government Exhibits

Newell Exhibit 1—Map of Kootenai Valley, Idaho, showing drainage district boundaries and observation wells.

Newell Exhibit 2—Photostat copy of topographic map of Kootenai Valley, Idaho, U.S. Geological Survey indicating "Critical Areas".

Newell Exhibit 3—Stream Flow, Kootenai River and Tributaries, Leonia, Idaho, to Port Hill, Idaho.

Newell Exhibit 4—Kootenai River Cross Sections, Bonners Ferry, Idaho, to Kootenai Lake, British Columbia.

Newell Exhibit 5—Topography and Ground Water Observations, Kootenai Valley Drainage Districts, Bonners Ferry, Idaho.

Newell Exhibit 6—Climate and Drainage, Kootenai Valley Drainage Districts, Bonners Ferry, Idaho.

Newell Exhibit 7—Topographic map, Kootenai Valley, Idaho (9 sheets).

Newell Exhibit 8—Well Observations, Kootenai Valley Drainage Districts, Bonners Ferry, Idaho (33 sheets).

Newell Exhibit 9—Ground Water Report, Kootenai River Investigation, Memorandum relative to District No. 7. June, 1933.

Newell Exhibit 10—Ground Water Report, Kootenai River Investigation, Memorandum relative to District No. 4. June, 1933.

Newell Exhibit 11—Effects of proposed Regulated Water Levels, Kootenai River, on water table and drainage outlets, Kootenai Valley Drainage Districts. June, 1933.

Davenport Exhibit 1—Effects of Proposals in the Application of the West Kootenay Power and Light Company, Limited, on Water Levels of the Kootenai River in the United States, by R. W. Davenport. June, 1933.

Jessup Exhibit 1—Compilation of Base Data Kootenai River Investigation, Idaho, 1932, by L. T. Jessup, May, 1933.

Jessup Exhibit 2—Effects of Proposed Regulated Water Levels, Kootenai River, on Crop Production, Kootenai Valley Drainage Districts, by L. T. Jessup.

Clark Exhibit 1—Statement *re* Indian allotments included within Drainage Districts Numbers 3, 6, 7, 11, 12 and 13, Boundary County, Idaho.

State of Idaho Exhibits

Exhibit 1—Report by Guy C. McGee, on Kootenai Valley Flood Control.

Exhibit 2—Extract from *Spokane Chronicle,* August 19, 1933, entitled "Additional Power Dangled as Plum."

Exhibit 3—Protest of Isabella Wigley Ennis, Drainage District No. 6, near Copeland, Idaho.

Exhibit 4—Protest of John Davidson, Bonners Ferry, Idaho.

Exhibit 5—Protest of J. H. Guthrie, Sr., Drainage District No. 6, near Copeland, Idaho.

Exhibit 6—Protest of J. H. Cave, Bonners Ferry, Idaho.

Exhibit 7—Protest of Boundary County, Idaho.

West Kootenay Power and Light Company, Limited, Exhibits

Exhibit 1—Engineering data, Kootenay Lake Storage, April, 1932.

Exhibit 2—Engineering data, Kootenay Lake Storage, August 30, 1932.

Exhibit 3—Engineering data, Kootenay Lake Storage. Study of effect of river improvements and dyking. March 10, 1933.

Exhibit 4—Discussion of the water table in its relation to the river, foothills and drain ditches; pumping, elevation of sump gauges, and reference points, 1930 and 1931. March 31, 1932. By Fred Mathews.

Exhibit 5—Effect on water levels of operation of Corra Linn plant and dam with particular reference to the effect during May and June, 1933.

Exhibit 6—Statement in connection with the Application of the West Kootenay Power and Light Company to the International Joint Commission, by T. H. Hogg, Consulting Engineer. August 16, 1933.

INDEX

To facilitate reference, the Index has been arranged in four sections, each in alphabetical order, the first covering the physical features and history of the Kootenay Valley, and the other three corresponding to the cases included in the report: Creston Project; Kootenay Farm; and Granite and Corra Linn Dams.

PHYSICAL FEATURES AND HISTORY

CRESTON PROJECT

KOOTENAY FARM

GRANITE AND CORRA LINN DAMS